

An Anatomical Studies on *Canavalia virosa* (Roxb.) Wight & Arn.

S Swathi^{1*} and Dr S Karpagam²

Department of Botany, Queen Mary's College, Chennai-4, Tamilnadu, India.

Corresponding author

1 Research Scholar,

2 Associate Professor,

Department of Botany,

Queen Mary's College, Chennai-600004,

Tamilnadu, India.

ABSTRACT:

Canavalia virosa is a leguminous, wild plant, commonly known as “wild sword bean” in india one of the medicinal plants used by the tribal people for the treatment of scorpion bite, malaria and splenomegaly. To understand about the plant and its morphological importance, anatomical and histochemical localization studies were conducted. Anatomical studies of leaf, petiole, mid-vein, stem and stomata were also done to determine the presence of specific cells such as sclerenchyma bundle sheath, prism of calcium oxalate crystals, paired foliar epidermal cells with solitary styloid crystals, non-glandular uniseriate trichome, protoxylem lacunae in stem and paracytic stomata are diagnostic characters which would help in the identification of the plant. Shape and arrangement of the cells and other related structures also play major role in delimiting the taxa.

KEY WORDS:

Canavalia virosa, Anatomy, Histochemistry, Leaf, Petiole, Stem.

Date of Submission: 11-01-2023

Date of acceptance: 27-01-2023

I. INTRODUCTION:

Numerous side effects of synthetic drugs have led to the usage of medicinal plants as a reliable source of therapy. Medicinal herbs, have been discovered and used in traditional medicine practices since pre-historic times. Many different therapeutic plants are used in customary. Indian system of the drug for the production of Ayurveda, Siddha and Unani medicine. The curative uses of plants have been well documented in ancient Rig Veda (1500- 400 BC) (Hassan *et.al.*, 2018; Suganthi *et.al.*, 2020).

Pharmacognosy is a significant part of drug store that incorporates the logical investigation of underlying, physical, compound, biochemical and organic properties of unrefined medications and quest for new medication from plant, creature and mineral sources (Muthuraj *et.al.*, 2021).

The Fabaceae known as the legume or pea family, are a large and economically important family of flowering plants. It is of cosmopolitan distribution, with approximately 730 genera and 19400 species securing in third place after Asteraceae and Orchidaceae with respect to species richness at global level (Soledad *et.al.*, 2011). It includes trees, shrubs and herbaceous plants perennials, annuals, which are easily recognized by their legume fruits and their compound, stipulated leaves.

According to Smartt (1990) the genus *Canavalia* encompass four subgenera with 51 species widely distributed in tropical and subtropical regions of the world (Cunha *et.al.*, 2009). *Canavalia* species occurring on the coastal sand dunes are also promising source of proteins and essential amino acids (Bressani *et.al.*, 1987; Sridhar and Seena, 2006).

Canavalia virosa (Roxb.) Wight & Arn (Wild Sword bean) (Kaatu kozhi avarai) belongs to Fabaceae family is a climbing perennial, common throughout india and found wild in scrub jungles (Mohammad *et.al.*, 2019). *C.virosa* seed, leaves, root and bark are used for scorpion sting, malaria, intestinal worms, infective hepatitis, splenomegaly, wind colic and other stomach ailments and so on (Lavanya *et.al.*, 2014). *C.virosa* is a synonym of *Canavalia cathartica* Thouars.

Traditional knowledge of medicinal plants and their use by indigenous healers and drug development in the present are not only useful for conservation of cultural tradition and biodiversity but also for community

health care and drug development in the local people (Mahbubur *et.al.*, 2014). The correct identification of the medicinal herb is mandatory for effective healing properties of the herbal preparation.

The present study was aimed to identify the anatomical analysis of various plant parts namely leaf, petiole, petiolule, trichome, stem and stomata of the species of *C.virosa*. Anatomical characterization is important taxonomic parameters for the certification and quality control of medicinal plants for correct identification.

II. MATERIALS AND METHODS:

The plant *Canavalia virosa* were collected from the wilds of Hanumanthai- Kunnavakkam, Chengalpattu, Kanchipuram, Tamil Nadu. The plant was identified based on Gamble (1935) and the voucher specimen was deposited in the Department of Botany, Queen Mary's College.

Anatomical studies were performed by the procedure followed by (Ogunkunle and Oladele 2008; Sadegh *et.al.*, 2017).

The specimens were fixed in FAA Solution (70% ethyl alcohol, formalin and acetic acid in the ratio of 90ml:5ml: 5mlv/v) for anatomical studies. The specimens were sectioned free hand and stained using Safranin and Fast green as a double staining method (Ogunkunle and Oladele 2008; Sadegh *et.al.*, 2017).

The distribution of stomata and the types were studied by taking stomatal peelings using Safranin and Fast green as a double staining method (Ogunkunle and Oladele 2008; Sadegh *et.al.*, 2017).

III. RESULTS AND DISCUSSION:

PLANT MORPHOLOGY:

C. virosa is a woody and deciduous climber. It is a thornless vine with thick, twining and climbing stems growing up to 8 meters (Plate:1-A and B).

C. virosa has 10 to 20cm long trifoliately compound leaves with alternate phyllotaxy. The petiole is 5 to 10 cm long. The leaflets are ovate and 5 to 10 cm long and 2.5 to 8 cm wide. These leaflets are chartaceous with entire margins, acuminate at apex, rounded at base, glabrous above and slightly puberulous below (Yellowish-brown coloured hairs). The petiolules are about 5mm long. The stipules are subulate and 2-3mm long (Plate:1-C). The Bark of *C.virosa* is warty and old stems show vertical veins. The Branchlets are glabrous.

The flowers of *C.virosa* are pink 10 to 20 cm long in axillary racemes. The peduncle is about 15 cm long and the pedicel of each flower is 3-4mm long. Both are sparsely hairy (Plate:1-D). The flowers are fragrant. The flower is 2.5cm across (Plate:1-E). The calyx-tube is 1.3-1.5 cm long and 0.5-0.8 cm wide. This tube is 2-lipped; the upper is 2-lobbed (5 mm long) and the lower is 3- dentate (1-2 mm long) (Plate:1-F). The corolla is pink and lilac-coloured. It is composed of a 2x2.5 cm reflex standard, 2 narrow wings (2 cm long and 0.6 cm wide) and 2 incurved keels (2.5 cm long and 0.7 cm wide) (Plate:1-G). The staminal sheath is 2.5 cm long with (9+1) 10 filaments (0.6-0.7 mm long) diadelphous condition and 22 to 25 mm long anther (Plate:1-H). The style is curved and about 2.5 cm long and the ovary is about 0.5 cm across with many ovules (Plate:1-I, J and K).

The fruit of *C.virosa* is a pod, 10 to 15 cm long and 2 to 2.5 cm wide. It is oblong, compressed and pubescent with obtuse and horned apex with 0.5-0.7 mm peduncle. The pod is 5-12 seeded. (Plate:1-L). The seeds are smooth, glabrous and 1.5 to 1.8 cm long and 1 cm wide (Plate:1-M).

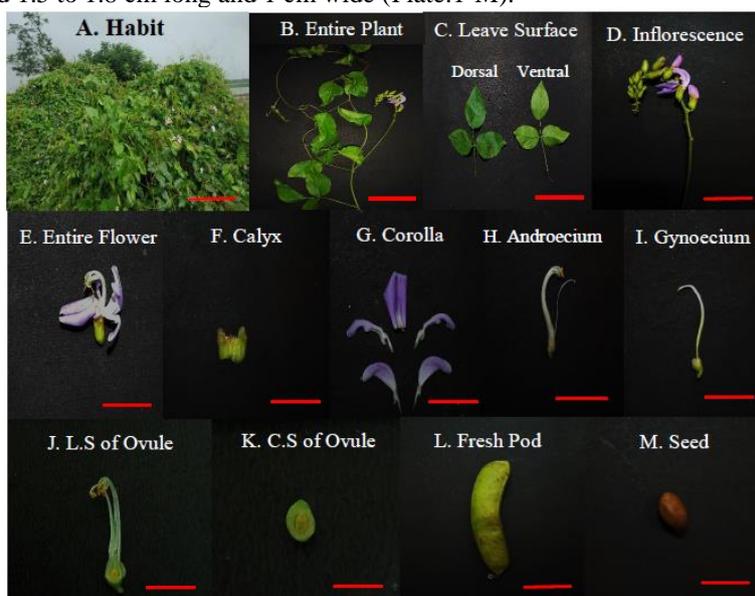


Plate 1- Morphology of *Canavalia virosa*

MICROSCOPICAL CHARACTERS:

ANATOMY OF LEAF:

Canavalia leaf is a dorsi-ventral type. Wedge shaped structure convexity on the abaxial surface. Epidermis is prominent with single layer and covered by a thick-cuticle vary in depth but are often tabular in shape. Uniseriate on both the upper and lower epidermis.

It consists of elongated cells perpendicular to the surface of the blade. It appears more compact than the spongy tissue. Palisade tissue occur in a single row with elongated columnar cells. Palisade parenchyma is located on the adaxial side of the leaf lamina laden with abundant chloroplast appearing dark green in colour. Spongy mesophyll on abaxial side. Spongy tissues are composed of almost four to five layers of chlorenchymatous loosely arranged cells with many wide intercellular spaces. Spongy tissue are arranged dominantly horizontal to the surface of the leaf. Bundle sheath is present in between the spongy parenchyma tissue of the lamina cells.

Hypodermis is made of 4 to 5 layer of continuous collenchyma cells in the mid-rib region. Thick-walled collenchyma are observed in patches to the inner side of the upper and lower epidermis. The ground tissue is extensively made up of thin-walled parenchyma cells. Parenchyma cells are present throughout the mid-rib. Sclerenchyma cells are present in 3 -4 layers below the collenchyma. The sclerenchyma bundle cells surround the adaxial and abaxial vascular strands. Vascular bundles at the mid-rib region are devoid of bundle sheath layers. Xylem and phloem cells are present. Protoxylem and metaxylem are present. Medullary rays are present in between protoxylem and metaxylem. Phloem cells are exterior present below the xylem (Plate-2: A).

Sadegh *et.al.*, (2017) studied the anatomical characterisation of *in vivo* and *in vitro* grown leaf of *Canavalia rosea*. He observed that vascular bundle of *in vivo* grown *C.rosea* shows closed U-shaped and *in vitro* grown plants show kidney shaped bundles.

ANATOMY OF PETIOLE:

Petiole of *C. virosa* shows plano-convex outline with two protuberances on the adaxial side. It shows a single layered epidermis covered by a thin cuticle. Collenchyma cells are observed in 2 or 3 layers, followed by 2 to 4 layers of thin-walled parenchyma cells. Pericyclic fibres are lignified, 2 or 3 layered and occur as a continuous ring. Some of the innermost cortical layer i.e., outer boundary of the pericyclic fibres contains prisms of calcium oxalate crystals.

The two accessory vascular bundles which are small and circular in outline are situated on either side of the median vascular cylinder towards upper side of the petiole. On the dorsal side 2 or 3 layered sclerenchyma fibres are seen as a cap. The cylindrical vascular bundle shows well developed phloem followed by a thin ring of cambium then xylary elements facing the pith. The xylem is endarch in nature and consists of vessels and tracheids (Plate-2: B).

Cunha *et.al.*, (2013) observed the absence of sclerenchyma fibre in Accessory bundle sheath in *C.maritima*.

ANATOMY OF PETIOLULE:

Petiolule of *Canavalia virosa* is oval shape in outline. Epidermis is single layered and covered by a thick-walled cuticle. The ground tissue is made up of small spherical closely arranged thick-walled parenchyma cells. Small groups of pericyclic fibres are noticed.

In the centre, an 'U' shaped vascular bundle is present. Phloem exterior surrounds the xylem cell. Xylem interior facing towards the pith. Protoxylem and metaxylem cells are present. Medullary rays are present in between the xylary vessels and tracheids. Pith is absent in petiolule (Plate-2:C). Non-glandular uniseriate trichomes are present on all the sides (Plate-2:D).

ANATOMY OF STEM:

C.virosa stem are more or less circular in shape. Epidermal cells are polygonal, oval or irregular with thin layer of cuticle. Hairs are with short basal cell and a large terminal cell were observed. Cortex region has a distinct outer collenchyma, middle sclerenchyma and inner parenchyma. Collenchyma tissues is located below the epidermis just below the ridges. Thin-walled collenchyma cells are present with no intercellular space. Branchy sclereids are found below the collenchyma cells. Homogenous parenchyma cells are present below the sclerenchyma.

Large vascular bundles are conjoint, collateral and endarch type. Cambium cells are present in between xylem and phloem. Protoxylem lacunae are present in between xylem vessels. Protoxylem and Metaxylem are present. Pith is composed of polygonal, oval and spherical parenchymatous cells with small intercellular space (Plate-3: E).

Similar result was found by Cunha (2013) where the cuticle is thick layer, intercellular spaces are prominent at the ridged cortex area. The fascicular and interfascicular cambium is distinct in *C.maritima* whereas it is absent in *C.virosa*. Protoxylem lacunae are absent in *C.maritima*.

ANATOMY OF MID-VEIN (Primary tracheary elements):

The primary tracheary cells have a variety of secondary wall thickenings. The wall appears in a specific ontogenetic series that indicates a progressive increase in the extent of the primary wall area covered by secondary wall material.

Cells with thickenings are parallel transverse bands like the rungs of a ladder with coils interconnected called Scalariform thickenings (Plate-3: F).

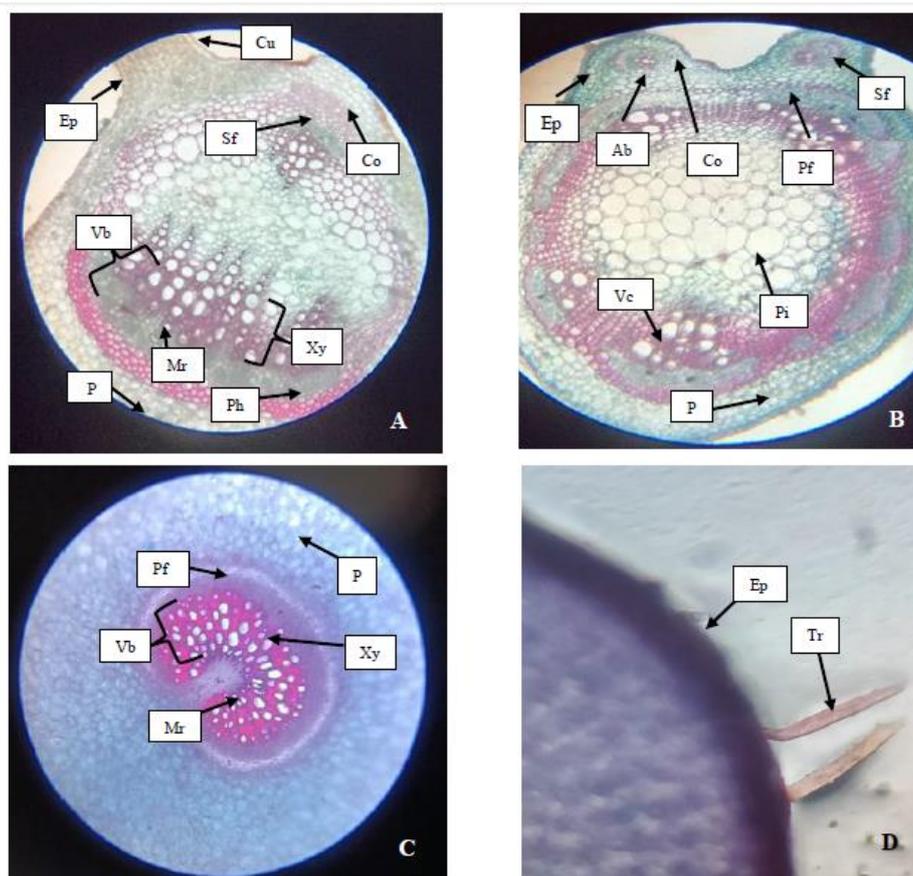
ANATOMY OF STOMATA:

The guard cells of dicotyledons are commonly crescent shaped, with rounded ends (Kidney shaped) as seen from the surface, and have ledges of wall material on both the upper and lower epidermis.

In the surface view, the adaxial and abaxial epidermal cells possess grossly wavy outlines. The adaxial epidermis are slightly larger in size compare to the abaxial side. Both the epidermis is perforated by paracytic stomata but the frequency is less in adaxial epidermis. Paracytic cells shows the parallel- celled one or more subsidiary cells border the stoma parallel with the long axes of the guard cells. The occurrence of paired epidermal cells with solitary styloid crystals in both the epidermal of the leaf is a noteworthy feature (Plate-3: G and H).

Similarly, Sadegh *et.al.*, (2017) studied the presences of *in vivo* and *in vitro* Stomata of *C.rosea*. He observed that *in vivo* abaxial surface of epidermis are not homogenous and distribution of stomata are dense compare to *in vitro* adaxial surface.

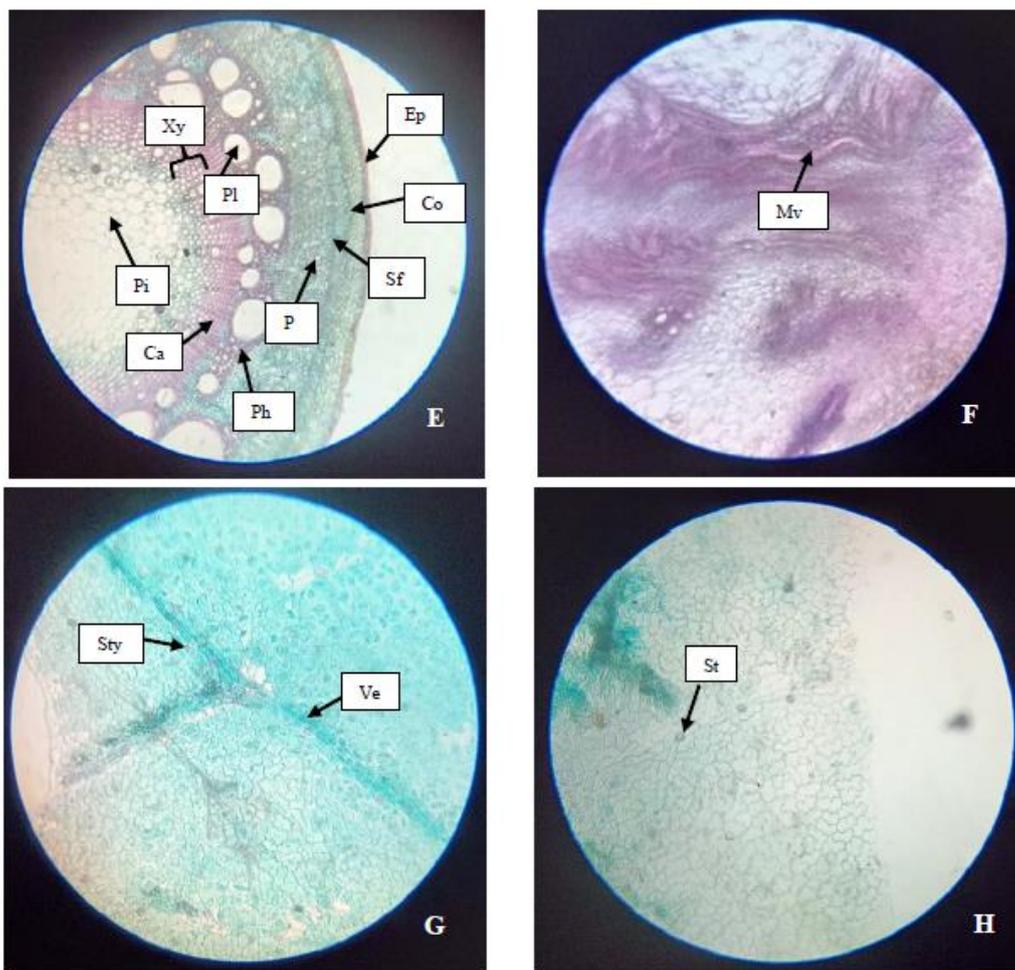
Plate-2: Showing the structure of Leaf, Petiole, Petiolule and Trichome of *Canavalia virosa*



**A: T.S. of Leaf (Mid-rib); B: T.S. of Petiole; C: T.S. of Petiolule;
D: Non-glandular uniseriate Trichome- Enlarged.**

Ab: Accessory bundle; Co: Collenchyma; Cu: Cuticle; Ep: Epidermis; P: Parenchyma; Pf: Pericyclic fibre; Pi: Pith; Ph: Phloem; Sf: Sclerenchyma fibre; Tr: Trichome; Vb: Vascular bundle; Vc: Vascular cylinder; Xy: Xylem.

Plate-3: Showing the structure of Stem, Mid-vein and Stomata of *Canavalia virosa*



E: T.S of Stem; F: T.S of Mid-vein; G: Stomata-Upper epidermis; H: Stomata-Lower epidermis.

Ca: Cambium; Co: Collenchyma; Ep: Epidermis; Mv: Mid-vein; P: Parenchyma; Pi: Pith; Ph: Phloem; Pl: Protoxylem lacunae; Sf: Sclerenchyma fibre; St: Stoma; Sty: Styloid crystals; Ve: Vein; Xy: Xylem.

IV. CONCLUSION:

Canavalia virosa is a medicinal plant and is used for various treatment. The present study are probably the records to find out the basic (or) key anatomical features which could be used as identification features in leaf, petiole, petiolule, mid-vein, stem and stomata. The observed anatomical and morphological characteristics were the key features that can be used to diagnose this plant.

ACKNOWLEDGEMENT:

We thank the Principal of Queen Mary's college for giving us the permission to conduct the research work in the Department of Botany Queen Mary's college for providing all facilities for the study.

REFERENCES:

- [1]. Hassan A., Hassan S and Nasir M.A. An Ethnobotanical Study of Medicinal Plants used by Local People of Neel Valley, Ramban, Jammu and Kashmir, India. S.S.R.G. Int. J Agric. Env. Sci., 2018; 5:17-20.
- [2]. Suganthi S and Malarvizhi V. Phytochemical composition, Larvicidal and Antiproliferative Effect of *Canavalia virosa*. Int J Sci Res Sci Technol., 2020; 7(3): 197-206.
- [3]. Muthuraj S., Seeni M K., Muthusamy P and Sampath kumar T. Review on scope of Pharmacognosy graduate in various government research institute in India. J. Phytopharm., 2021; 10(4): 266-271.
- [4]. Soledad Molaes and Ana Ladio. The Usefulness of Edible and Medicinal Fabaceae in Argentine and Chilean Patagonia: Environment Availability and other sources of supply. Evidence- Based Complementary and Altern Med., 2011; 1-12.
- [5]. D' Cunha M., Sridhar K R., Young CC and Arun AB. Nutritional evaluation of germinated seeds of coastal sand dune wild legume *Canavalia cathartica*. Int. Food Res J., 2009; 16: 249-260.

- [6]. Bressani R., Brenes R.S., Garcia A and Elias L.G. Chemical composition, amino acid content and protein quality of *Canavalia spp* seeds. *J.Sci. Food Agric.*, 1987; 40: 17-23.
- [7]. Sridhar K.R and Seena S. Nutritional and Antinutritional significance of four unconventional legumes of the genus *Canavalia*- A Comparative study. *Food Chem.*, 2006; 99: 267-288.
- [8]. Mohammad Mahmudal Hasan, Mohammad Abdullah Taher, Azizur Rahman Md and Tanvir Muslim. Analgesic, Anti-diarrheal, CNS- depressant, Membrane Stabilizing and cytotoxic Activities of *Canavalia virosa* (Roxb) W& A. *Bangladesh Pharmaceutical J.*,2019;22(2): 214- 218.
- [9]. Lavanya Alagusolaiyan, Shakila Ramachandran, Sasikala Ethirajulu, Ayyasamy Sengan. Pharmacognostical studies on the leaves of *Canavalia virosa* (Roxb) Wight & Arn. *Asian J Tradit Med.*, 2014; 9(1): 8-17.
- [10]. Mahbubur Rahman A.H.M, Ismot Ara Parvin M. Study of Medicinal uses on Fabaceae Family at Rajshahi, Bangladesh. *Res. Plant Sci.*, 2014; 2(1): 6-8.
- [11]. Gamble JS. *The Flora of Presidency of Madras. Vol I.* Kew: Royal Botanic Gardens, 1935, 359-360.
- [12]. Ogunkunle A.T.J, Oladele F.A. Leaf Epidermal studies in some Nigerian species of *Ficus L.* (Moraceae). *Plant Syst.Evol.*, 2008; 274: 209-221.
- [13]. Sadegh Mohajer, Rosna Mat Taha, Normadiha Mohamed &Ummi Nur Abdul Razak. Baybean *Canavalia rosea* (Sw.) DC.); organogenesis, morphological and anatomical studies, *Gayana Bot.*, 2017; 74(1).
- [14]. Ruzin SE. *Plant microtechnique and microscopy.* Oxford University Press., New York. 322p.
- [15]. D'Cunha M and Sridhar K R. Agrobotanical traits of wild legumes *Canavalia* on the coastal sand dunes. *J Agric Tech.*,2013; 9(7): 1821-1836.