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ANATOMICAL STUDIES ON *TEPHROSIA PURPUREA* (L.) PERS.- A MEDICINALLY IMPORTANT SPECIES

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ABSTRACT

Tephrosia purpurea (L.) Pers. is the most common species belonging to family Fabaceae. The plant is medicinally important, bears antibacterial, antifungal and anticancerous constituents. It also possesses hepatoprotective activity. Juice mixed with molasses given for stomach pain and applied on skin eruptions. Present study deals with morphology, stem and leaf anatomy, dermatology. This work has been carried out to standardize the species.

INTRODUCTION

The genus *Tephrosia* Pers. comprises *c*. 345 species (Mabberley, 2008). It is one of the largest genera in the family Fabaceae (Geesink, 1984). It has pantropical distribution. Its highest concentration found in Africa-Madagascar (c. 170 spp.), Australia (c. 90 spp.) and central and tropical North America (c. 45 spp.) (Lewis *et al.*, 2005). In South Asia genus is represented by 29 species, two subspecies and one variety (Kumar and Sane, 2003). In India genus is represented by 27 species and one variety (Sanjappa, 2010).

Tephrosia purpurea (L.) Pers. is the most commonly occurring species belonging to family *Fabaceae*. The plant is bitter, astringent, acrid, thermogenic, anthelmintic, digestive, laxative, diuretic, uterine tonic, anti-inflammatory, depurative, styptic, debostruant, alexiteric, alterant and antipyretic. The roots are useful in inflammations, skin diseases, scrofula, elephantiasis, dyspepsia, stomachalgia, flatulence, haemorrhoids, asthma, bronchitis, anaemia, hepatosplenomegaly, verminosis, strangury, dysmenorrhoea chronic fever, boils, pimples, odontalgia and gingivitis. The leaves are useful in dyspepsia, pectoral diseases, haemorrhoids, syphilis, gonorrhoea, and bruises. The seeds are useful in skin diseases and rat poisoning (Nambiar, 1996). Root is taken in diarrhoea. The leaves are useful in jaundice. A decoction of the dried plant is given in diseases of liver, spleen, breast, bronchitis, gonorrhoea, asthma, tumours, ulcers and piles. It is also taken as blood purifier. Seed is used in abortion and flavouring milk (Sahu, 1984).

MATERIALS AND METHODS

The plant specimens were collected from Parli-Vaijnath, Dist. Beed (MS)-431515, Field No. 1017, Latitude N18^{O}84’53”, Longitude E76^{O}51’98”, Altitude 1512 ft. Transverse sections of stem and leaf were taken by free hand sectioning method with the help of razors, followed by double staining and permanent mounting. Trichomes observed and studied by scraping with the help of blades. For microphotography and dimensions Pixel-Pro software attached to Labomed Lx-400 microscope was used.

RESULTS AND OBSERVATIONS

A) MORPHOLOGY:-

Tephrosia purpurea (L.) Pers., Syn. Pl. 2: 329. 1807; Baker in Hook.f., Fl. Brit. India 2: 112. 1876. *Cracca purpurea* L., Sp. Pl. ed. 1, 2: 751. 1753. *Gelega purpurea* L., Sp. Pl. ed. 2, 2: 1063. 1763. *Galega lanceaefotia* Roxb., Fl. Ind. 3: 386. 1832. *Galega diffusa* Roxb., Fl. Ind. 3: 387.

1832. *Tephrosia diffusa* (Roxb.) Wight & Arn., Prod. 213. 1834. *Tephrosia purpurea* (L.) Pers. var. *diffusa* (Roxb.) Aitch. *Tephrosia purpurea* (L.) Pers. var. *pubescens* Baker in Oliver Fl. Trop. Africa 2: 125. 1871 & in Hook.f., Fl. Brit. India 2: 113. 1876. *Tephrosia wallichii* Grah. ex Fawcett & Rendle, J. Bot. 55: 35. 1917. *Tephrosia hamiltonii* J.R. Drum, ex Gamble, Fl. Pres. Madras 320. 1918.

Vernacular Names: Sanskrit: *Sarapunkhah, Banah, Banapunkhah*; English: *Wild indigo, Purple Tephrosia*; Hindi: *Sarphonka*; Kannada: *Phanike, Empali, Koggili, Vajaranili*; Malyalam: *Kolinnil, Kattamari, Koluva, Kottikolinnil*; Tamil: *Kattukolincai;* Telugu: *Vempali, Bontavempali;* Gujarati: *Ghodakan;* Ceylon: *Kavilai;* Marathi: *Unhali.*

Much-branched, perennial herbs or undrshurbs, 30-80 cm tall; stems woody at base; branches spreading, sparsely pilose. Leaves pinnate, 4.5-10 cm long; petioles 6-12 mm long;stipules linear- subulate, 2-3 mm long. Leaflets 9-21, oblong to oblanceolate, 0.8-3 × 0.3-1 cm, acute or cuneate at base, emarginate and apiculate at apex; glabrous above, sparsely appressed hairy beneath; petiolules 1-2 mm long, hairy. Flowers 2-4 together in extra-axillary racemes 5.5-12 cm long; pedicels slender, 2-3 mm long; bracts subulate, as long as the pedicels. Calyx 4 mm long; thinly silky outside; teeth triangular-subulate, as long as the tube. Corolla pink or pinkish-purple, twice as long as the calyx. Standard broadly ovate to orbicular, 8.7 × 10.0 mm, clawed; wings 6.7 × 3.8 mm, auricled on standard side, clawed; keel 4.3 × 3.2 mm, , clawed, auricled. Stamens 10, diadelphous, stamina tube 4 – 6 mm long, filaments 3.5 mm long, vexillary filament upto 8 mm long. Style upto 4.8 mm long, upper half glabrous, stigma penicillate at base. Pods oblong- linear, 2.5-4.5 cm long, curved at the tip, glabrescent. Seeds 5-8 (10), oblong, 2-3 mm long, pale brown, mottled with black spots. (Plate - 01) (Table- I).

Fl. & Fr.: August – December.

B) Anatomy of Stem: The transverse section of stem showed epidermis as the outermost single layer, composed of barrel-shaped, squarish cells, papillate cells covered externally by thick cuticle. Average size *c*. 10.467 × 6.879 µm and range *c*. 4.84 – 15.74 × 4.03 – 9.28 µm. Bicelled glandular trichomes reported from epidermal cells, average *c*. 20.915 × 9.120 µm and range *c*. 18.13 – 25.35 × 7.95 – 10.07 µm. Below epidermis 2 – layered hypodermis or outer cortex found; cells are rectangular, squarish, polygonal with angular thickening measured average *c*. 9.886 × 5.748 µm and range *c*. 7.70 – 16.75 × 4.64 – 8.68 µm. Inner cortex lies below hypodermis, composed of 3 – 11 layered thin walled, ovate-elliptic, polygonal, irregular walled

parenchyma cells having intercellular spaces, measured average *c*. 13.092 × 10.131 µm and range *c*. 7.72 – 21.03 × 5.32 – 15.69 µm. Few inner cortical cells contain tannin and some are filled with crystals. Endodermis is single layered composed of barrel – shaped cells. Pericycle found next to endodermis in patches separated by parenchyma cells. Pericycle composed of double walled, circular, oval, elliptical, polygonal, vertically elongated fibres, measured average *c*. 10.238 × 6.396 µm and range *c*. 3.70 – 17.39 × 2.15 – 10.72 µm.

Phloem found beneath pericycle upto 10 – layered with rectangular cells, average *c*. 5.707 × 4.10 µm and range *c*. 2.82 – 10.57 × 2.02 – 6.37 µm. Vascular cambium reported below phloem, 3 – 4 layered, rectangular cells, average *c*. 8.224 × 3624 µm and range *c*. 6.06 – 10.72 × 2.23 – 4.87 µm. Metaxylem circular to polygonal situated towards the periphery, average *c*. 17.639 × 16.962 µm and range *c*. 13.54 – 22.65 × 13.82 – 18.95 µm. Protoxylem vessels rectangular to polygonal, situated towards the centre, average *c*. 5.621 × 6.423 µm and range *c*. 4.77 – 6.92 × 5.13 – 9.20 µm. Large pith located centrally composed of circular, oval, pentagonal to polygonal, thin walled, loosely arranged parenchyma cells, average *c*. 40.387 × 35.661 µm and range *c*. 10.45 – 70.95 × 8.47 – 64.97 µm. In some pith cells starch grains reported (Plate -02a) (Table- II).

C) Anatomy of Leaf: The transverse section of the leaf showed typical dorsiventral structure. The epidermis of both the surfaces single layered, covered externally with thick cuticle. The upper epidermal cells upright, oval, polygonal, rectangular, barrel-shaped, average *c*. 23.240 × 16.255 µm and range *c*. 13.92 – 33.03 × 13.36 – 18.53 µm. It shows presence of glandular trichomes which measured 50.35 – 68.37 µm long on both surfaces but more common on lower epidermis. Some of the glandular trichomes sessile with quadricellular head measured 21 – 48 µm in length. The lower epidermal cells comparatively smaller in size, oval, polygonal, rectangular, barrel-shaped, elongated, average *c*. 13.452 × 9.182 µm and range *c*. 10.23 – 16.90 × 8.14 – 10.64 µm. The cells of epidermis at the midrib portion are oval, circular or polygonal and smaller than those in the lamina portion.

Mesophyll showed clear cut differentiation into palisade and spongy tissues. Below the upper epidermis 4 – 6 layered palisade with columnar, vertically elongated, compactly arranged, filled with chloroplasts observed which measured average c. 27.188 × 11.745 µm and range c. 18.45 – 36.39 × 6.39 – 35.50 µm. The spongy mesophyll cells 3 – 5 layered beneath the lower epidermis, oval, polygonal to irregular, loosely arranged filled with starch grains, average c. 26.427 × 20.253 µm and range c. 18.99 – 30.21 × 15.80 - 24.17 µm.

At the midrib region the lower epidermis followed by 4 – 6 layered angular collenchyma a part of ground tissue, average *c*. 7.254 × 5.886 µm and range *c*. 4.23 – 9.68 × 3.57 – 8.56 µm. This region followed by 3 – 5 layered sclerenchymatous patch composed of compactly arranged, circular, oval to polygonal cells, average *c*. 10.241 × 8.208 µm and range *c*. 6.21 – 19.61 × 4.24 – 14.52 µm. Sclerenchymatous patch followed by 4 – 8 layered phloem of squarish, rectangular to polygonal cells, average *c*. 6.765 × 6.153 µm and range *c*. 4.47 – 12.19 × 3.75 – 9.49 µm. Phloem followed by metaxylem vessels, circular to polygonal, situated towards periphery, average *c*. 13.690 × 11.148 µm and range *c*. 10.41 – 19.86 × 8.06 – 15.18 µm. Protoxylem rectangular to polygonal, situated towards centre, average *c*. 9.529 × 5.989 µm and range *c*. 8.57 – 10.86 × 4.30 – 8.11 µm. Centrally located pith cells parenchymatous 2 – 4 layered, oval, thin walled, pentagonal, and hexagonal to rectangular shaped (Plate – 02 b, c) (Table –III).

D) Dermatology: Leaf showed presence three types of trichomes viz. simple, unicellular, trichomes with bulbous base and pointed end average length, *c*. 731.66 µm and range *c*. 250 – 1200 µm glandular trichomes which measured 50.35 – 68.37 µm long on both surfaces but more common on lower epidermis. Some of the glandular trichomes sessile with quadricellular head measured 21 – 48 µm in length.

Stomata anisocytic (Cruciferous), amphistomatic, *c*. 19.16 × 13.33 µm in average and range *c*. 17.50 – 20.00 × 12.50 – 15.00 µm (Plate – 02 d, e) (Table – IV).

Upper epidermal cells much larger (average *c*. 23.240 × 16.255 µm and range *c*. 13.92 – 33.03 × 13.36 – 18.53 µm.) than lower epidermal cells (the average cell size *c*. 13.452 × 9.182 µm and range *c*. 10.23 – 16.90 × 8.14 – 10.64 µm).

Table I: Morphological Characters:

	Characters	Observation in *T. purpurea* (L.) Pers.
Vegetative	Habit	Suffruticose Perennial Herb or shrub
	Plant Height	0.7 m
	Life Form	Erect
	Surface	Smooth
Leaflets	Number	11 – 21
	Shape	Oblanceolate
	Dimensions (cm)	0.9 – 2.5 × 0.4 – 0.9
	Apex	Mucronate
	Upper Surface	Glabrous
	Lower Surface	Hairy
Stipules	Length (mm)	5.0 – 7.0
	Shape	Lanceolate
	Apex	Acute
	Pubescence	Sparsely Hairy
Stalk	Petiole length (mm)	2.0 – 2.5
	Petiolule length (mm)	2.5
Inflorescence	Length (cm)	9.0
	Position/Type	Axillary
	Peduncle (cm)	11.4
	No. of flowers	*c*. 7
Bracts	Shape	Subulate
	Pubescence	Hairy
Calyx	Calyx Tube (mm)	4021
	Upper Sepal (mm)	2.5
	Lower Sepal (mm)	2.5
	Teeth Shape	Triangular-subulate
	Apex	Acute
	Pubescence	Hairy
Corolla	Colour	Pink-Pinkish
	Standard Size (mm)	8.7 × 10.2
	Standard Shape	Orbic0ular
	Wing Size (mm)	6.7 × 3.8
	Keel Size (mm)	4.3 × 3.2
Androecium	Staminal Sheath Length (mm)	6.0
	Filament Length (mm)	3.5
Gynoecium	Ovary Length (mm)	6.3
	Style Length (mm)	4.8
	Style Pubescence	Glabrous
Pods	Size (cm)	4.5 × 0.6
	Shape	Linear slightly falcate
	No. of Seeds	5 – 7
Seeds	Size (mm)	3.2 × 1.1
	Shape	Oblong
	Colour	Pale brown

Table II: Stem Anatomy

Cell Type	Dimensions in *T. purpurea* (L.) Pers.	
	Average (µm)	Range (µm)
Epidermis	10.467 × 6.879	4.84 – 15.74 × 4.03 – 9.28
Hypodermis	9.886 × 5.748	7.70 – 16.75 × 4.64 – 8.68
Cortex	13.092 × 10.131	7.72 – 21.03 × 5.32 – 15.69
Pericycle Fibres	10.238 × 6.396	3.70 – 17.39 × 2.15 – 10.72
Phloem	5.707 × 4.10	2.82 – 10.57 × 2.02 – 6.37
Vascular Cambium	8.224 × 3.624	6.06 – 10.72 × 2.23 – 4.87
Metaxylem	17.639 × 16.962	13.54 – 22.65 × 13.82 – 18.95
Protoxylem	5.621 × 6.423	4.77 – 6.92 × 5.13 – 9.20
Pith	40.387 × 35.661	10.45 – 70.95 × 8.47 – 64.97
Glandular Trichomes	20.915 × 9.120	18.13 – 25.35 × 7.95 – 10.07

Table III: Leaf Anatomy

Cell Type	Dimensions in *T. purpurea* (L.) Pers.	
	Average (µm)	Range (µm)
Upper Epidermis	23.240 × 16.255	13.92 – 33.03 × 13.36 – 18.53
Lower Epidermis	13.452 × 9.182	10.23 – 16.90 × 8.14 – 10.64
Angular Collenchyma	7.254 × 5.886	4.23 – 9.68 × 3.57 – 8.56
Palisade Mesophyll	27.188 × 11.745	18.45 - 36.39 × 6.39 – 35.50
Spongy Mesophyll	26.427 × 20.253	18.99 – 30.21 × 15.80 – 24.17
Phloem	6.765 × 6.153	4.47 – 12.19 × 3.75 – 9.49
Metaxylem	13.690 × 11.148	10.41 – 19.86 × 8.06 – 15.18
Protoxylem	9.529 × 5.989	8.57 – 10.86 × 4.30 – 8.11

Table IV: Dermatology

Cell Type	Dimensions in *T. purpurea* (L.) Pers.	
	Average (µm)	Range (µm)
Simple Trichomes	731.66	250 – 1200
Glandular Trichomes	59.23	50.35 – 68.37
Sessile Trichomes with quadricellular head	34.50	21.00 – 48.00
Stomata Type	Anisocytic Cruciferous	--
Stomata Dimensions	19.16 × 13.33	17.50 – 20.00 × 12.50 – 15.00
Stomata Presence	Amphistomatic	

CONCLUSION

Pods linear to slightly falcate, style glabrous. Angular collenchyma 4-6 layered, 3-5 layered sclerenchymatous patches. Stem showed pericycle fibres up to 10 layered, starch grains reported in pith cells. Trichomes of 3 types viz. Simple, glandular and sessile. Stomata anisocytic (Cruciferous), amphistomatic. These characters of morphology, leaf anatomy and dermatology are diagnostic to *Tephrosia purpurea* (L.) Pers. and may be useful to standardise the species.

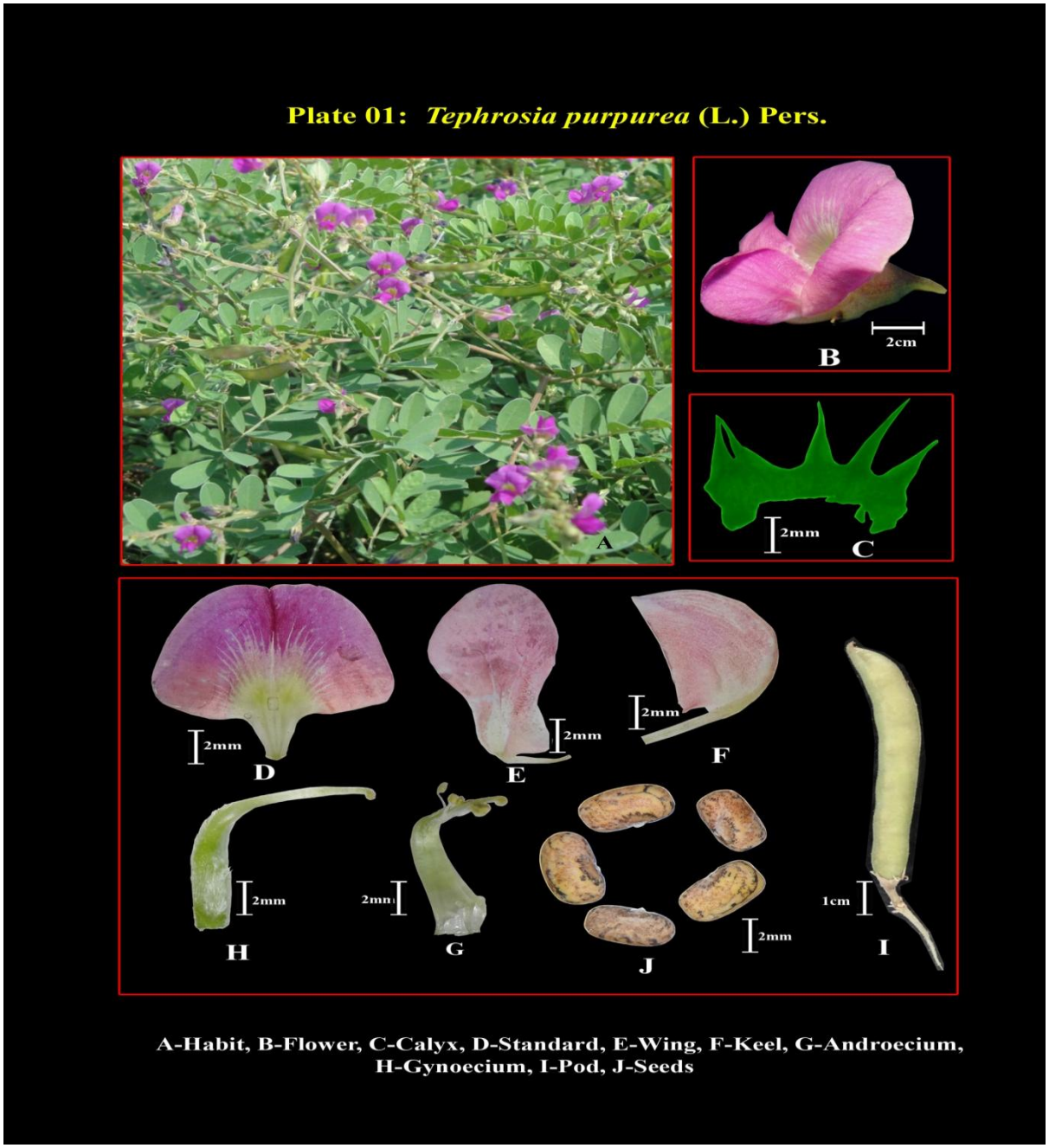
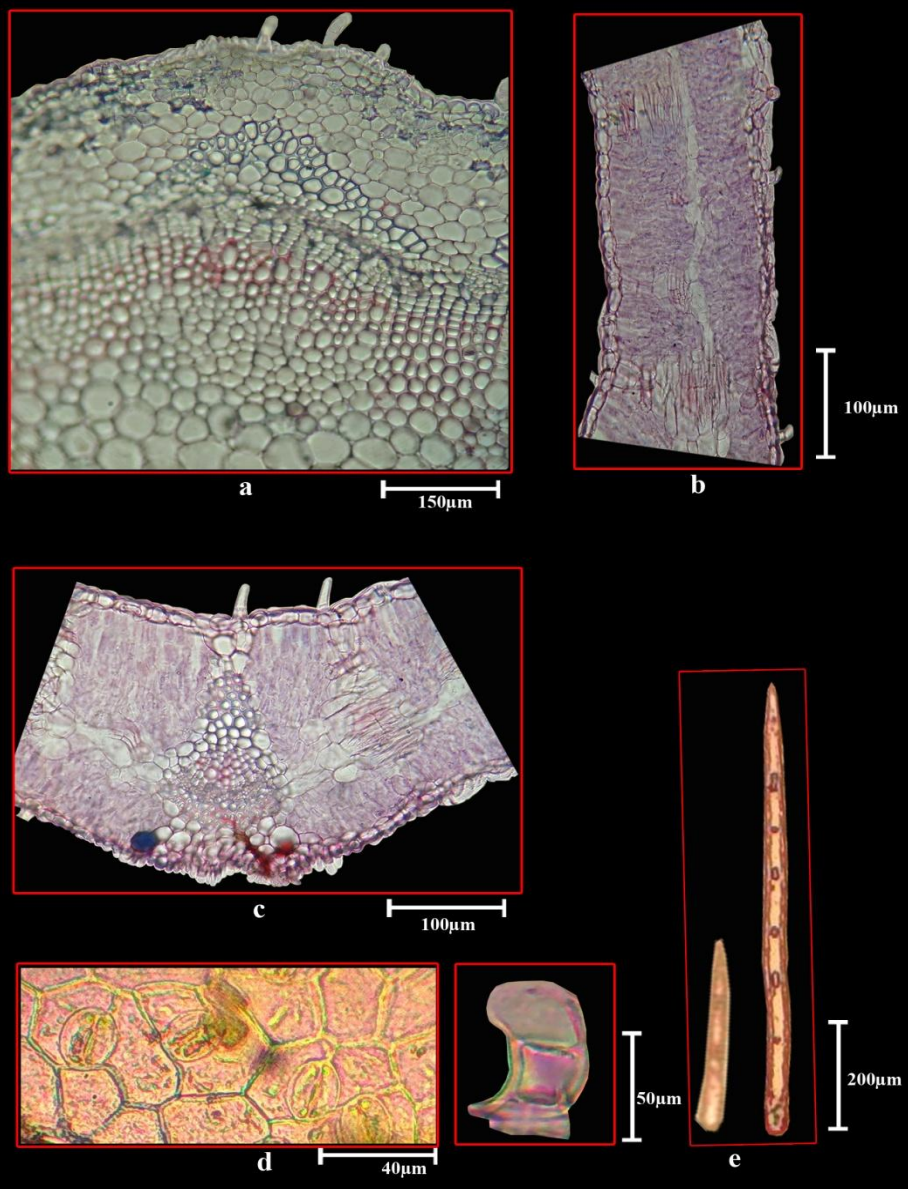


Plate 02:- *Tephrosia purpurea* (L.) Pers.



a) T.S. of stem b) T.S.of leaf through lamina c) T.S. of leaf through midrib d) Stomata e) Glandular trichome, f) Simple trichome

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