

MACRO- AND MICROMORPHOLOGICAL STUDY OF
TRICHODESMA CALCARATUM COSS.

M.A. Ramadan

Pharmacognosy Department, Faculty of Pharmacy, University of Assiut,
Assiut, Egypt

ABSTRACT

The macro- and micromorphological characters of the leaf, stem and root of *Trichodesma calcaratum* Coss. growing in Egypt are presented with the aim of finding out the characteristic features by which the plant could be identified from other closely related species or varieties.

INTRODUCTION

Trichodesma is a small genus belonging to the family Boraginaceae. It is represented in Egypt by three species, *T. ehrenbergii* Schweinf.; *T. africanum* (L) R. Br. and *T. calcaratum* Coss. All growing in rocky grounds except *T. calcaratum* Coss. which grows as a weed in sandy places ^{1,2}.

Preliminary phytochemical investigation on *T. calcaratum* Coss. revealed the presence of pyrrolizidine alkaloids which are the characteristic type of alkaloids present in Boraginaceae ^{3,4}. This type of alkaloids has hepatotoxic and anticancer activities ^{3,4}.

Reviewing the current literature, little information could be obtained about the morphological characters of *T. calcaratum* Coss. ^{1,2,5}.

Therefore, it was deemed of interest to investigate the macro- and micromorphological characters with the aim of finding out the characteristic features by which the plant could be identified.

EXPERIMENTAL

Plant Material:

Flowering plants of *T. calcaratum* Coss. growing wild in EL-Kharga (The New Valley) were collected in January 1990. The plant was kindly authenticated by Dr. Moamen Mostafa, Lecturer of Plant Taxonomy, Faculty of Sciences, Assiut University. The separated parts were preserved in alcohol 70% containing 5% glycerin.

MACROMORPHOLOGY

Habitat

Trichodesma calcaratum Coss. (Fig. 1) is an annual, very bristly erect herb, 50-70 cm high with crowded inflorescences. It flowers during January to March.

I-The Root (Fig. 1A)

A distinct main tap root with lateral branches. Colour is purplish brown when fresh, dark brown when dry with short fracture. It measures 10-15 cm long and 0.3-1 cm in diameter.

II-The Stem (Fig. 1B)

The stem is herbaceous, cylindrical with slightly ribbed green, hispid surface. Branching is sympodially, and measures from 30-50 cm long. It has short fracture and slightly bitter taste.

III-The Leaf (Fig. 1B)

The leaves are narrowly linear to lanceolate, opposite, simple, entire, shortly petiolate in the upper part of the stem, petiolate at the lower, with acute apex. The petiole varies from 1.5-2.5 cm long.

Surface is hispid specially the lower one being covered with numerous, whitish, short, stiff hairs. The midrib is prominent on the lower surface. Leaves vary from 4-10 cm long and 0.5-2.5 cm wide and has slightly bitter taste and odourless.

MICROMORPHOLOGY

The Root (Fig. 2, 3)

A transverse section in the root appears nearly rounded in outline. It shows externally reddish brown cork followed by parenchymatous phelloderm surrounding a central cylinder of vascular tissues. The vascular tissue comprises a narrow phloem and a wide xylem. Medullary rays are multiseriate traversing the phloem and xylem.

The Cork (Fig. 2B, 3) is formed of 4-6 rows of brown tangentially elongated, radially arranged, rectangular tabular cells with thin non-lignified walls. They measure 113-170-226 μ in length, 40-60-80 μ in width and 26-30-34 μ in height.

Phelloderm (Fig. 2B) is composed of thin-walled parenchymatous cells. The inner 5-7 rows being slightly thicker.

Phloem (Fig. 2B) is formed of intermittent phloem tissue, sieve tubes, companion cells and phloem parenchyma but no phloem fibres.

The cambium (Fig. 2B) is represented by a complete ring of 4-7 rows of tangentially elongated, radially arranged, thin-walled meristematic cells.

The xylem (Fig. 2B, 3) is formed of a comparatively wide cylinder of lignified elements.

The vessels are mainly isolated or in small groups of 3-5 measuring 34-117-200 μ in diameter with bordered pitted walls, which are accompanied with tracheids, wood fibres and wood parenchyma.

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The tracheids have lignified walls and show simple pits and measure 280-325-373 μ in length and 53-63-73 μ in width.

Fibrous tracheids are lignified and measure 140-300-400 μ in length and 17-24-33 μ in diameter.

Wood fibres have slightly thick lignified walls, wide lumena and blunt or tapering apices and measure 570-598-626 μ in length and 20-26-33 μ in width.

Wood parenchyma cells are rectangular or subrectangular in shape with pitted lignified walls.

The medullary rays are bi- tri- to multiseriate formed of radially elongated parenchymatous cells. Cells adjacent to vessels or fibrous tracheids possess slightly lignified pitted walls.

The Powdered Root

Powdered roots (Fig. 3) is pale brownish yellow in colour, odourless and having slightly bitter taste.

It is characterised microscopically by the following:

1-Fragments of polygonal thin-walled non-lignified cork cells.

2-Fragments of tracheids, wood parenchyma with lignified pitted walls.

3-Fragments of xylem vessels with lignified pitted walls.

4-Fragments of wood fibres with lignified thin-walled, wide lumena and blunt to acute apices.

2-The Stem (Fig. 4)

A transverse section of the stem is almost circular in outline with 3-5 prominent ridges, consists of epidermis followed by a wide cortex then a comparatively narrow ring of vascular tissue enclosing a large pith.

Epidermis (Fig. 4B, 4C) is formed of one row of cells which appears as polygonal axially elongated cells with straight anticlinal walls. They are covered with thick smooth cuticle. Stomata are not observed. The epidermal cells measure 104-170-234 μ in length, 43-65-86 μ in width and 43-56-70 μ in height. Numerous non-glandular trichomes (Fig. 4C) are similar to those of the leaf.

Cortex (Fig. 4C) is formed of 1-2 rows of collenchymatous cells and 2-7 rows of thin-walled parenchymatous cells.

The pericycle (Fig. 4B) is formed of a complete ring of small thin-walled parenchyma.

Vascular tissue (Fig. 4B, 4C)

Phloem is formed of a complete ring of phloem tissue hardly differentiated into sieve tubes, companion cells and phloem parenchyma.

Xylem (Fig. 4B, 4C) is formed of lignified vessels, few fibres. The vessels are mainly solitary or arranged in radial groups with pitted and spiral thickenings and measure 26-56-87 μ in diameter. Fibres

(Fig. 4C) have rather straight thin lignified walls with wide lumena and acute to blunt apices. They measure 478-534-590 μ in length and 35-38-44 μ in width.

Medullary rays (Fig. 4B) are mostly multiseriate. The cells are radially elongated with slightly thick lignified walls.

Pith (Fig. 4B) consists of a wide region in the centre and formed of large cellulosic thin-walled more or less rounded parenchymatous cells. Calcium oxalate and starch granules are absent.

The Powdered Stem

Powdered stem (Fig. 4C) is brownish green in colour, odourless and having slightly bitter taste. It is characterised microscopically by the following:

- 1-Fragments of polygonal cells with straight anticlinal walls and covered with smooth cuticle.
- 2-Numerous covering trichomes which are unicellular, conical, stiff, whitish with acute apices, wide lumena and covered with thick warty cuticle.
- 3-Fragments of wood fibres with spindle shape, wide lumena, acute to blunt apices and slightly thick lignified walls.
- 4-Fragments of xylem vessels with spiral and pitted thickenings.
- 5-Fragments of medullary rays and wood parenchyma.

3-The Leaf (Fig. 5A)

The transverse section of the leaf shows an isobilateral structure. The palisade cells form an arc on the lower side. The midrib projects on the lower side only. The cortical region in the midrib and big veins consists of 1-2 layers of collenchyma followed by parenchymatous cells.

Epidermis (Fig. 5B, 6) epidermal cells are polygonal, with straight anticlinal walls in the upper surface and slightly wavy in the lower. The epidermis is covered with thick smooth cuticle. The upper epidermis measure 55-97-140 μ in length, 22-60-97 μ in width and 6-16-27 μ in height, while the lower epidermis measure 27-81-135 μ in length, 27-68-108 μ in width and 18-27-36 μ in height.

Stomata (Fig. 6) are anisocytic type. They are more or less oval in outline being more numerous on the lower surface. They measure 38-46-55 μ in length and 27-32-38 μ in width.

Trichomes (Fig. 6): Covering trichomes arising usually from 4-8 epidermal cells. The hairs are present on both surfaces of the leaf but more numerous on the lower one. They are unicellular, conical, stiff, whitish with acute apices, wide lumena and covered with thick warty cuticle and becoming very hard, bristle like on the margin of the leaf. They measure 432-816-1200 μ in length. The glandular trichomes are absent.

Mesophyll (Fig. 5C) is formed of an upper and lower palisade with a spongy tissue in between. Each palisade is formed of one row of cylindrical, columnar

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cells 80-91-102 μ long, and 27-36-44 μ in diameter. The spongy tissue consists of loosely packed parenchyma.

Midrib (Fig. 5B): The cortical tissue is formed of an upper and lower subepidermal masses of collenchyma each of 1-2 rows of polygonal collenchymatous cells with thick cellulosic walls showing no intercellular spaces. The rest of the cortical tissue is formed of almost rounded, large thin-walled parenchymatous cells.

The vascular bundles consists of radiate cellulosic thin-walled phloem and xylem formed of lignified spiral and pitted vessels measuring 11-16-22 μ in diameter, and thin-walled cellulosic parenchyma. The pericycle consists of two arcs of parenchymatous cells above and below the vascular bundles.

4-The Petiole

A transverse section in the petiole (Fig. 7A) is more or less rounded in outline with two wings showing a hairy epidermis followed by the cortex. It shows an arc of three collateral vascular bundles with the median one larger than the remainder. The pericycle is parenchymatous.

The epidermis (Fig. 7B, 7C) is formed of polygonal, tabular axially elongated cells with straight, thin cellulosic anticlinal walls. They are covered with smooth cuticle, carrying anisocytic stomata and covering trichomes resembling those of the leaf.

The cortex (Fig. 7B) is formed of one row of chlorenchymatous cells followed by 1-2 rows of collenchymatous cells. Several rows of parenchymatous cells with distinct intercellular spaces are present.

The pericycle (Fig. 7B) is formed of a ring of parenchymatous cells surrounding the vascular bundle.

The phloem (Fig. 7B) is formed of thin-walled soft cellulosic elements.

The xylem (Fig. 7B, 7C) is formed of lignified vessels with spiral thickenings.

Medullary rays (Fig. 7B) are biseriate, occasionally triseriate formed of radially elongated, thin-walled cells.

Powdered Leaf and Petiole

Powdered leaf (Fig. 6C, 7C) is green in colour, odourless and having slightly bitter taste. It is characterised microscopically by the following:

- 1-Fragments of upper epidermal cells which are polygonal cells with straight anticlinal walls showing anisocytic stomata.
- 2-Fragments of lower epidermal cells with slightly wavy anticlinal walls and showing anisocytic stomata.
- 3-Fragments of the epidermal cells of the petiole with straight anticlinal walls and showing anisocytic stomata.
- 4-Fragments of mesophyll parenchyma and palisade cells.
- 5-Fragments of lignified vessels with spiral and pitted thickenings.

6-Numerous covering trichomes which are unicellular, conical, stiff, whitish with acute apices, wide lumina and covered with thick warty cuticle.

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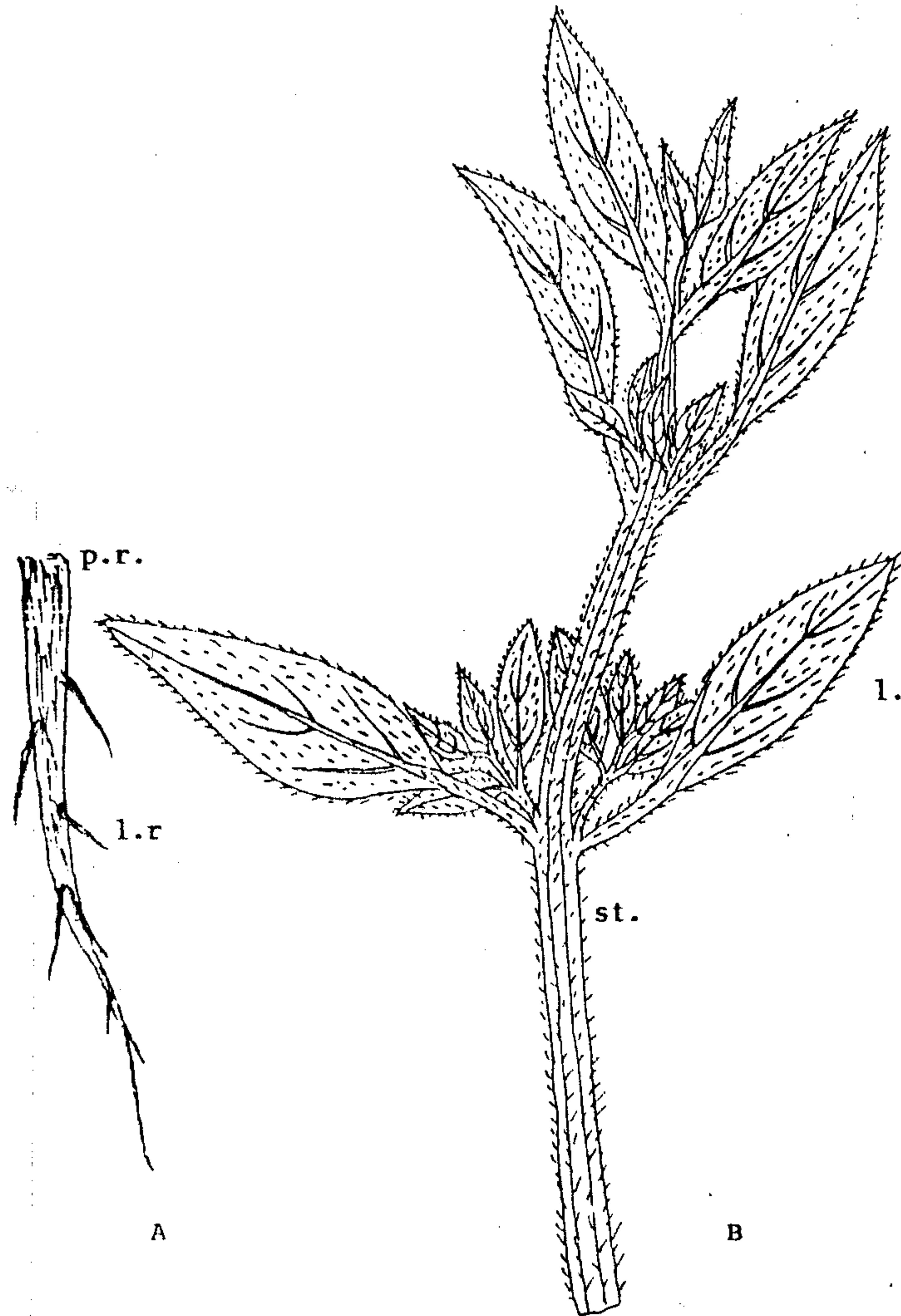


Fig. 1: Sketch of *Trichodesma calcaratum* Coss.

A. The root

X 0.5.

B. Aerial parts of the plant

X 0.5.

l., leaf; l.r., lateral rootlets; p.r., primary root; st., stem.

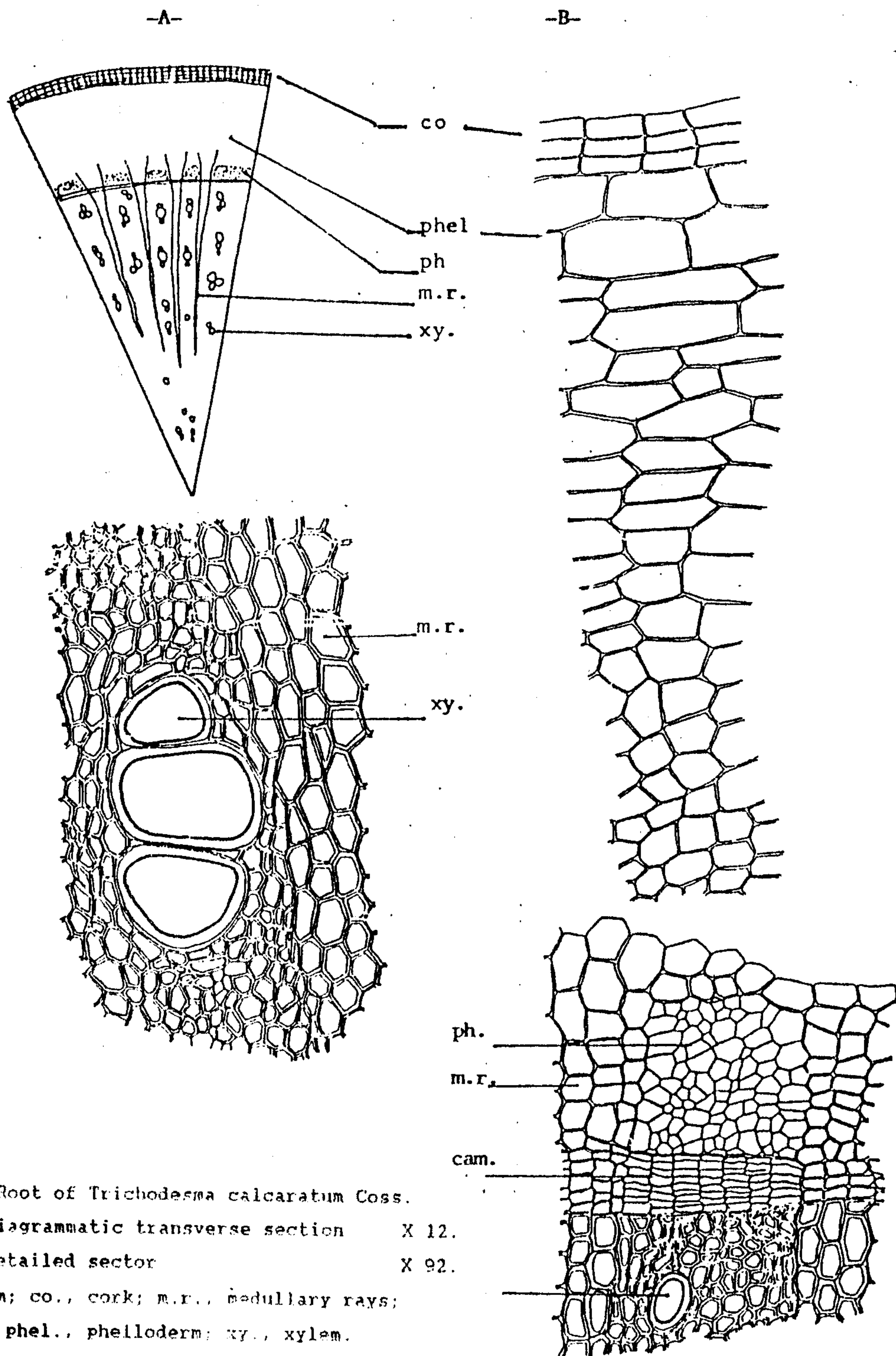


Fig. 2: The Root of *Trichodesma calcaratum* Coss.

A. Diagrammatic transverse section X 12.

B. Detailed sector X 92.

cam., cambium; co., cork; m.r., medullary rays;
ph., phloem; phel., phelloderm; xy., xylem.

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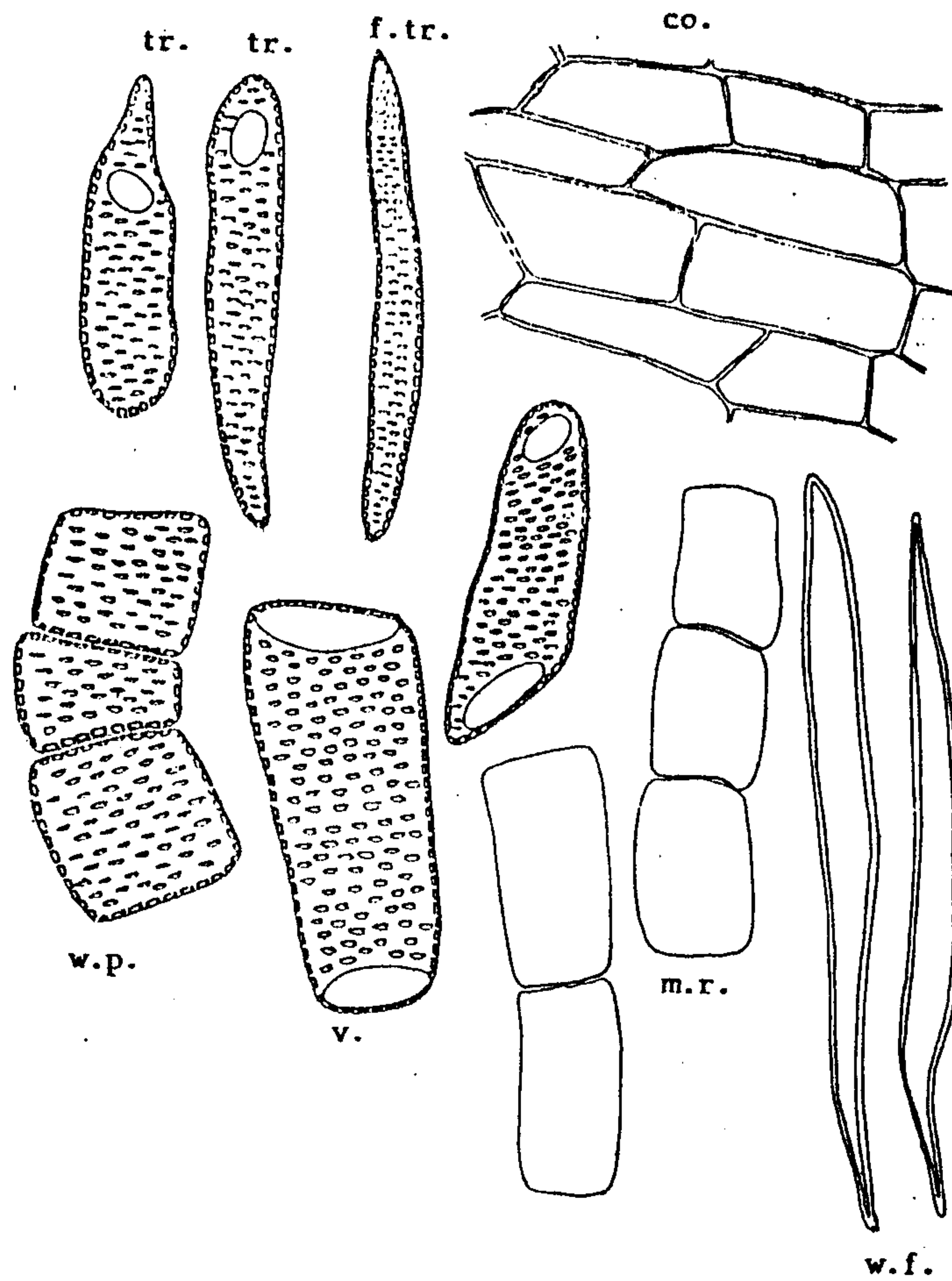


Fig. 3: Powdered Root.

X 122.

co., cork; f.tr., fibrous tracheid; m.r., medullary rays; tr., tracheids; v., vessels; w.f., wood fibre; w.p., wood parenchyma.

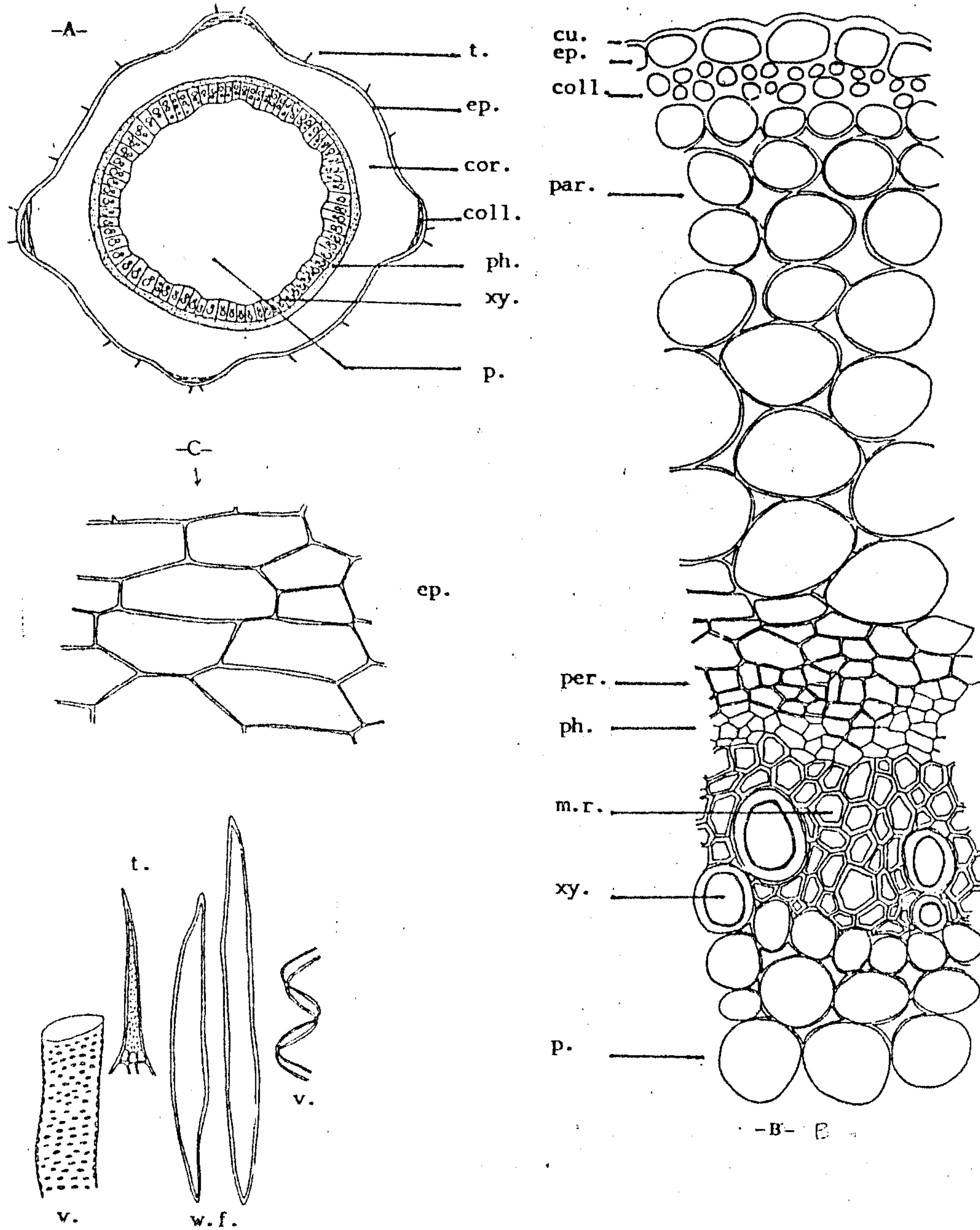


Fig. 4: The Stem of *Trichodesma calcaratum* Coss.

- A. Diagrammatic transverse section X 12.
- B. Detailed sector X 92.
- C. Powdered stem X 92.

coll., collenchyma; cor., cortex; cu., cuticle; ep., epidermis; m.r., medullary rays; p., pith; par., parenchyma; ph., phloem; t., trichomes (X25); v., vessels; w.f., wood fibres; xy., xylem.

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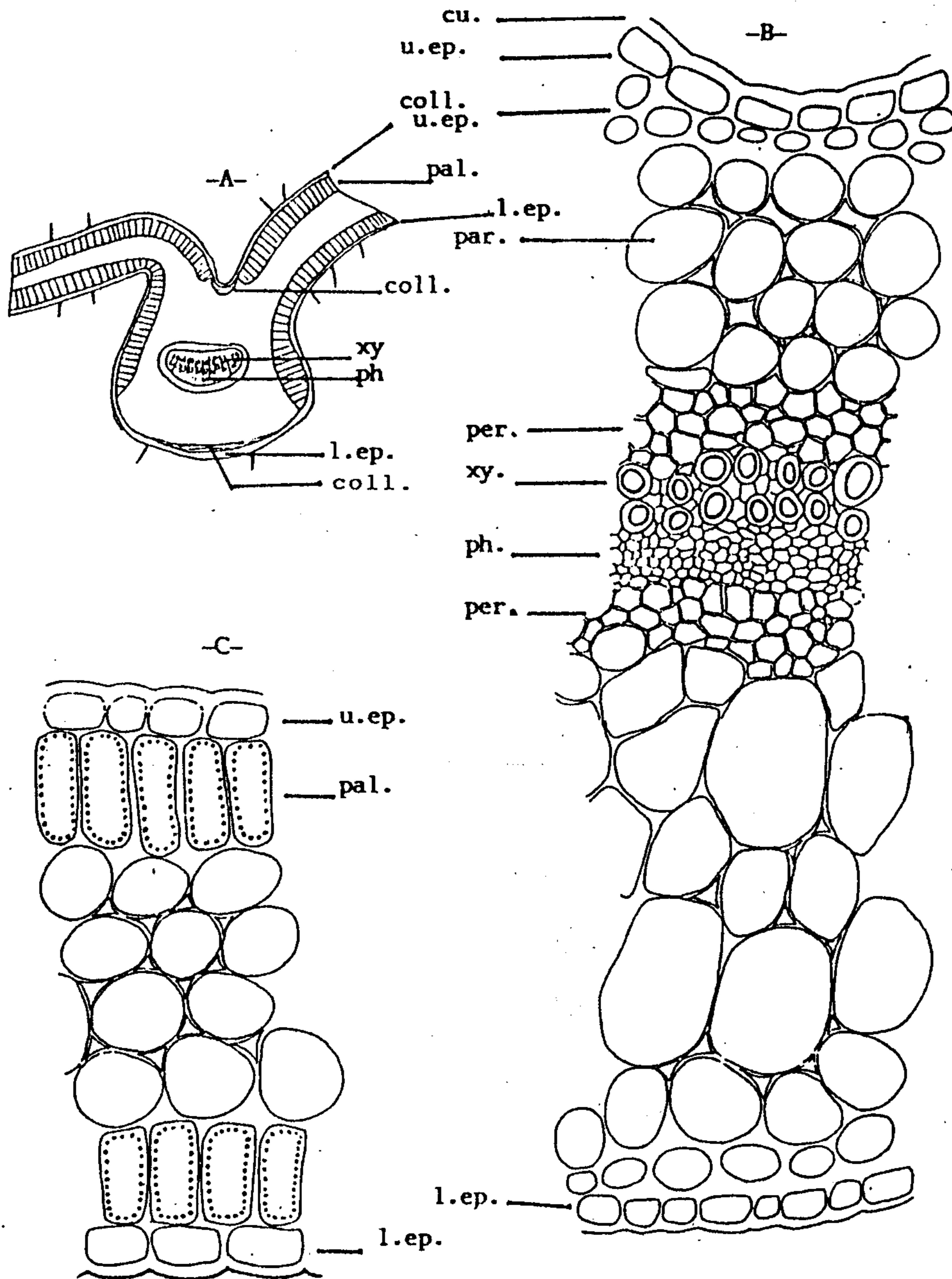


Fig. 5: The Leaf of *Trichodesma calcaratum* Coss.

- A. Diagrammatic transverse section of the leaf X 16.
- B. Detailed sector in the midrib X 150.
- C. Detailed sector in the lamina X 150.

coll., collenchyma; cu., cuticle; l.ep., lower epidermis; pal., palisade; par., parenchyma; ph., phloem; per., pericycle; t., trichomes; u.ep., upper epidermis; xy., xylem.

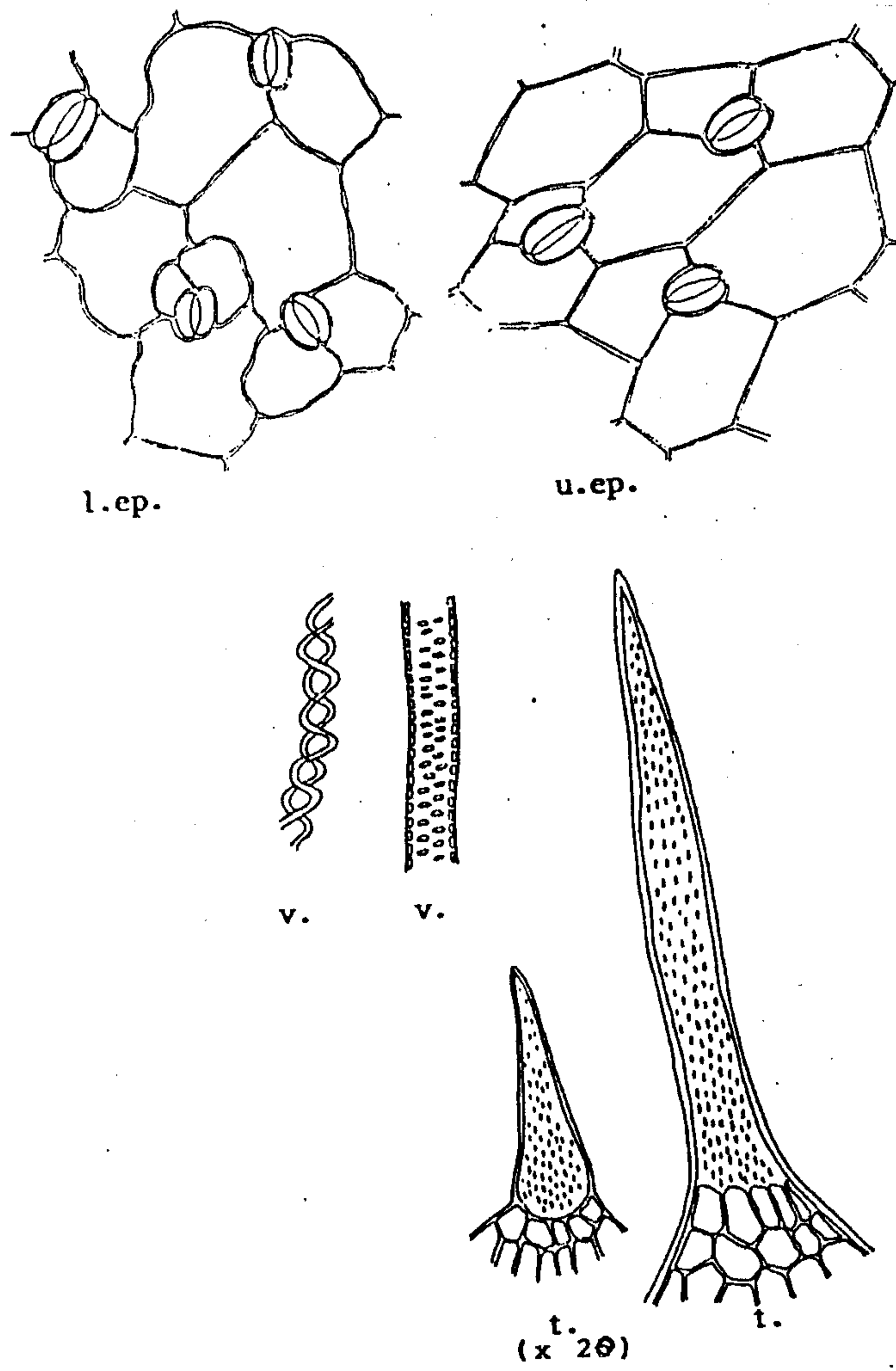


Fig. 6: Powdered Leaf

X 150.

l.ep., lower epidermis; s., stomata; t., trichomes; u.ep., upper epidermis; v., vessels.

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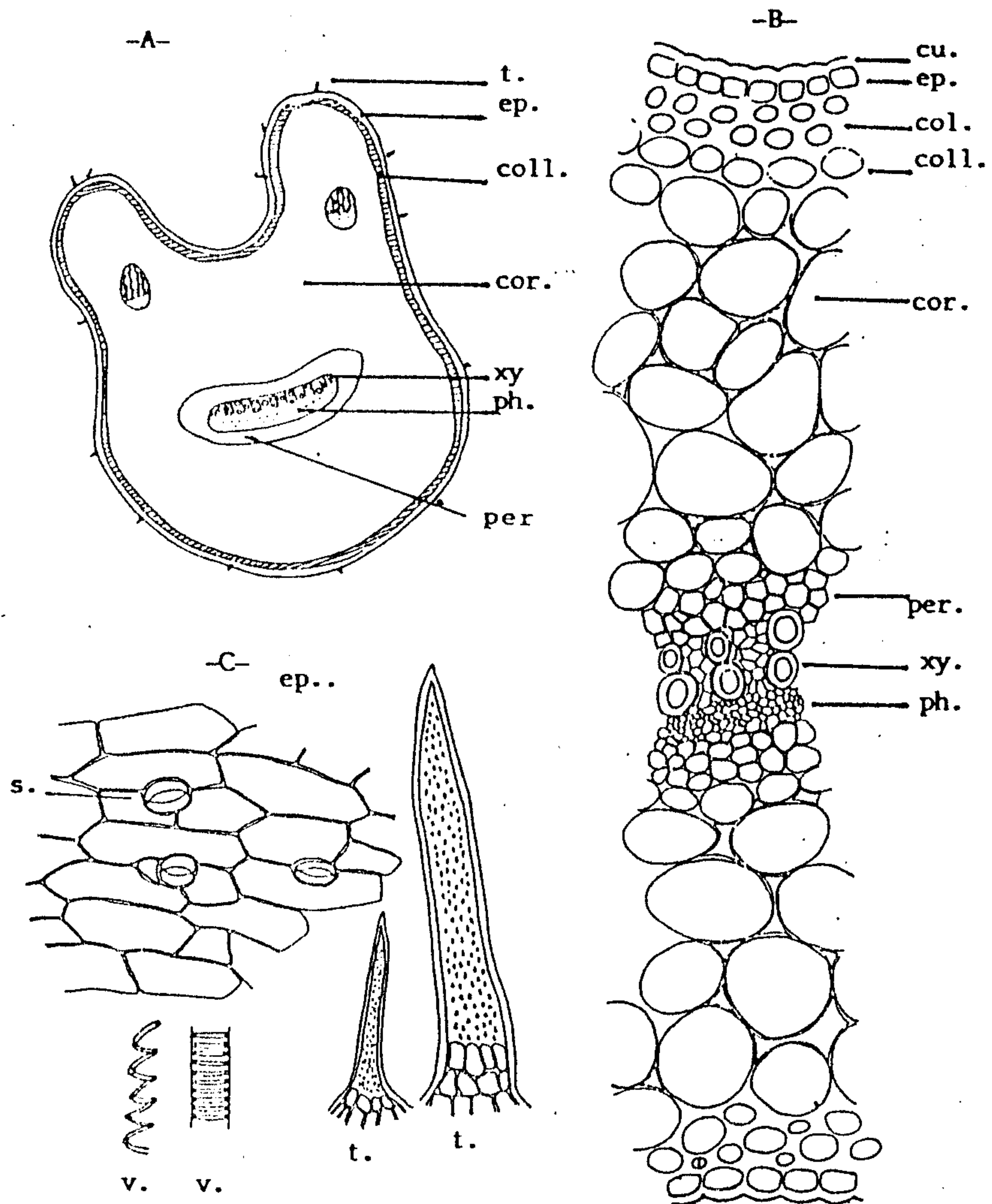


Fig. 7: The Petiole of the Leaf of *Trichodesma calcaratum* Coss.

A. Diagrammatic transverse section

X 16.

B. Detailed sector

X 150.

C. Powdered petiole

X 150.

col., chlorenchyma; coll., collenchyma; cor., cortex; cu., cuticle; ep., epidermis; per., pericycle; ph., phloem; s., stomata; t., trichomes; xy., xylem.

دراسة الصفات العيانية والمجهريه لنبات

التريكوودزما كلكاراتم كس

جزء أ: الاوراق ، السيقان ، والجذور

محمود احمد رمضان

قسم العقاقير - كلية الصيدلة - جامعة اسسيوط

نبات التريكوودزما كلكاراتم كس من النباتات التي تتبع الفصيلة البوراجينية والمعروفه باحتوائها على قلوانيات من نوع البيروليزيدين والمعروف أن هذه الأنواع من القلوانيات لها تأثير سام على الكبد وكذلك وجد أن لها تأثير فعال على بعض الخلايا السرطانية.

وقد دلت الدراسات الأولية على النبات أنه يحتوى على هذا النوع من القلوانيات. لذلك روى اجراء دراسته الصفات العيانية والمجهريه لاوراق وسيقان وجذور هذا النبات للتعرف عليه فى حالته الصحيحة أو على هيئته مسحوق.