SPECIES DELIMITATIONS IN CANNOMOIS: ANATOMICAL AND PHYTOCHEMICAL EVIDENCE.

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Systematics Honours Project - 1988

OUTLINE OF CONTENTS

INTRODUCTION

The genus *Cannomois* is a group of reed-like herbaceous perennials in the family Restionaceae. It has a distribution range which spans the Cape Floristic Region; from the Cedarberg in the north western corner throughout the Cape mountains into the southern and eastern Cape.

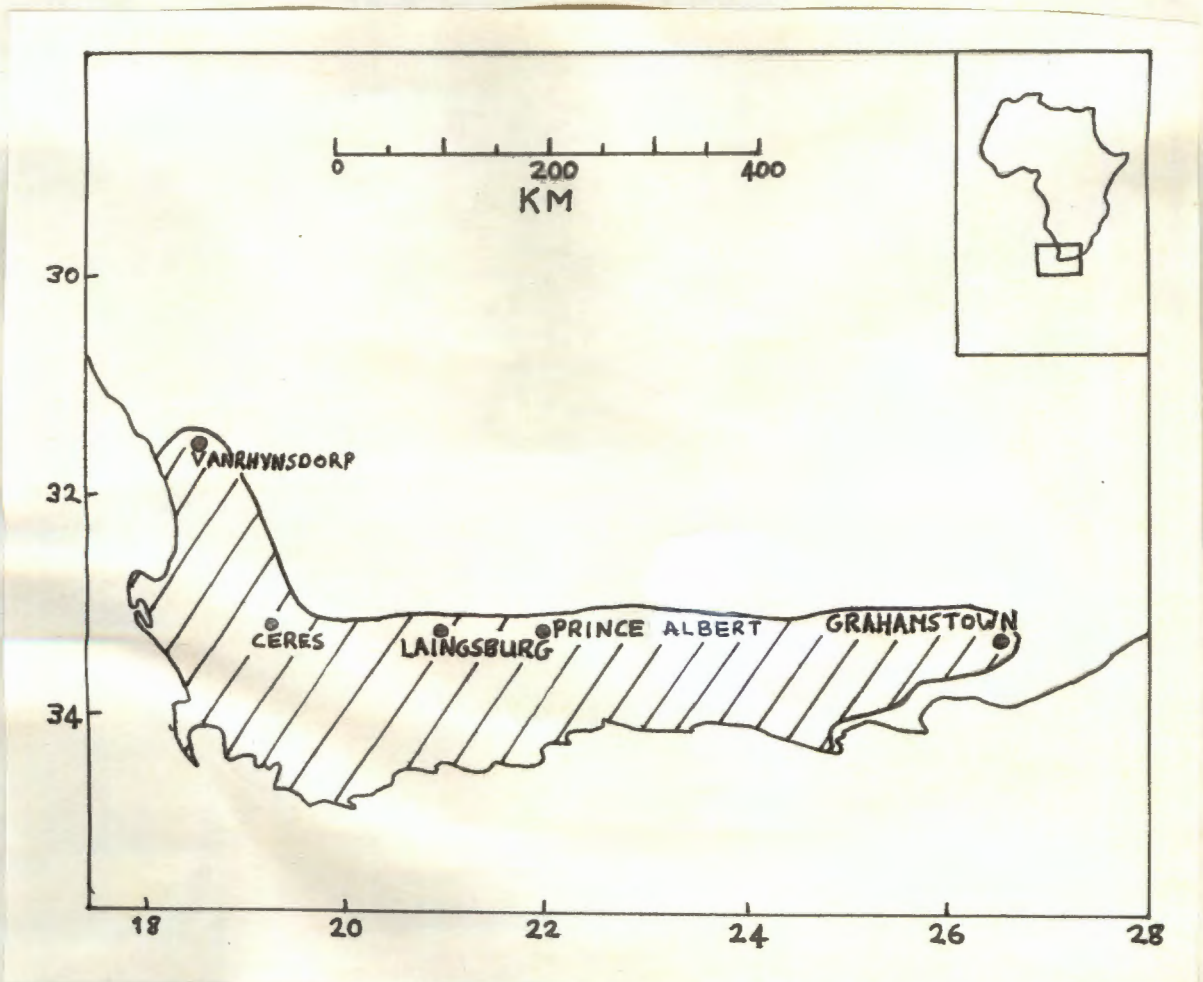

FIGURE 1. Distribution range of *Cannomois*.

Rainfall averages in this area vary between 250 mm per

annum in the Cedarberg and 1000 mm per annum in the coastal mountains of the Southern Cape. (Ref?)

The different species ocuppy a wide range of habitats including watercourses and seepages which are waterlogged for a substantial part of the year, sandy flats, and well-drained stony slopes.

The amount of variation in this genus obscures species boundaries, which are tentative because of the high degree of similarity in gross morphology, and intergrading of characters over geographical ranges (Linder 1985).

The genus was originally described by Baron Palisot de Beauvois in a study of the family by Desvaux in 1828, and the nomenclature has since been updated by Masters (1878), Pillans (1928) and Linder (1985). Cutler (1969) followed Gilg-benedict (date) in describing the anatomy of the Restionaceae. He separated the genus into two groups according to the position of the guard cells in the stomata. His survey was not very detailed, however. The use of such cryptic characters as anatomical and phytochemical, is necessitated by the lack of morphological characters and the variation displayed in these. The distribution of flavonoid pigments in the Restionaceae was found to correlate well with the taxonomy of the family (Harborne 1979; Harborne *et al.* 1985). Studies like those of Harborne have led to the refinement of methods for extracting and analyzing flavonoid constituents, and have provided a valuable record of chromatographic characteristics for a large range of flavonoids.

The problems in *Cannomois* which are addressed in this project are the general lack of consistent characters to delimit the species, and more specifically:

1).To assess the variation among populations of *C.virgata*, for which two distinct forms have been suggested (Linder 1985), notably a short (c.1m tall) form with a spreading habit which occurs on well drained slopes or plateaus, and a tall (up to 4m high), bamboo-like form occurring in moister conditions.

2).To examine the status of a putative hybrid from the Great Swartberg, which is morphologically intermediate between *C.virgata* and *C.scirpioides*.

3).To investigate an as yet undescribed *Cannomois* sp. from the Cedarberg.

This is then a preliminary survey of a few populations of various species in the genus, in order to find more characters in their anatomy and flavonoid profiles. These are used to test or verify hypotheses resulting from previous research.

The data is presented in the form of descriptions for each population, and summarized as a dendrogram of the populations.

CULM ANATOMY:

Materials and methods

Culm material was sampled in field populations representing the following species of *Cannomois* :

C.aristata Mast.
C.nitida (Mast.) Pillans
C.parviflora (Thunb.) Pillans
C.scirpioides (Kunth.) Mast.
C.virgata (Rottb.) Steud.,

as well as an undescribed species which will be referred to as *C.taylorii*, and a putative hybrid species between *C.virgata* and *C.scirpioides*. Study sites are indicated in Figure 2. Collection data is provided in appendix A. Voucher specimens were prepared for each population studied.

Fresh culm segments from different individuals in a population were fixed in FAA and stored in screw top jars. Segments were selected from halfway down the length of the culm, at the centre of an internode.

Three culms were sectioned in each population (3 different individuals). Culms were sectioned transversely with the aid of a Reichert-Jung sledge microtome, to a thickness of 15 um. A short segment of culm was clamped upright in cork as described by Cutler (1969). Grooves were

cut in the cork to accomodate the cylindrical culms without crushing them.

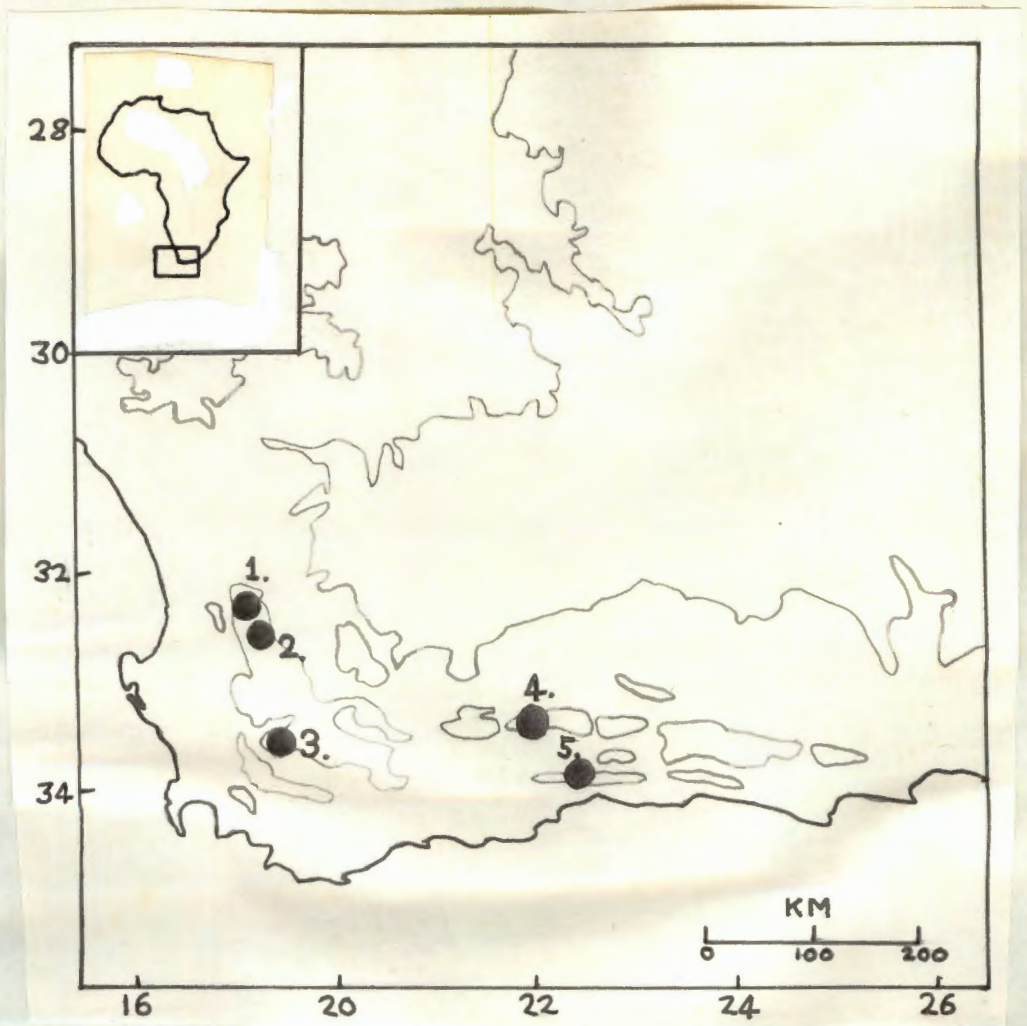

FIGURE 2. Locations of study areas where various *Cannomois* populations were sampled: (1) Pakhuis pass, N of Clanwilliam; (2) Cedarberg S of Uitkyk pass, including Wolfberg-Dwarsrivier area; (3) Fonteintjiesberg, Worcester area; (4) Great Swartberg; (5) Montagu pass, Outeniqua range. The contour represents an altitude of 1000 m.

The specimen was kept moist, and the microtome blade lubricated with 50% EtOH, by wetting them with a small camel hair brush. Two or three sections were obtained per culm, and transferred with the brush to 50% EtOH. The staining sequence was as follows. Distilled water (2min), Saffranine (10 min), 50% EtOH (till excess saffranine was removed (c. 30 s), 70% EtOH (3 min), 96% EtOH (5 min), Fast Green counter stain (10 min), 96% EtOH (1 min), 100% EtOH (3 min), xylene (3min). Sections were mounted on microscope slides using DPX solution as a mounting medium. Slides were dried overnight on a heated plate (50°C).

The sections were examined under a compound light microscope. A character list was drawn up with a range of character states exhibited throughout the study group, and the states for each population were recorded, noting variation at all levels.

Measurements were taken with the aid of a *Camera Lucida* attachment. At least ten measurements were taken over three individuals to estimate the average and standard deviation of a feature in each population.

The data was manipulated with the aid of the DELTA computer programme, which combines the information summarized in a characters file (list of characters and corresponding possible states), an items file which lists the coded character states for each taxon (population), and a specifications file, which codes the characters as being either binary, simple numeric, integer numeric, ordered

multistate or unordered multistate. (ref)

A description was produced for each population, and the data were further analyzed phenetically (UPGMA & COMPL) using the NT-SYS programme (ref) which produced a dendrogram with each population as an OTU. Numeric characters were transformed to binary or multistate characters for the analysis, by plotting the variation and separating into categories corresponding to discontinuities in the ranges. (ref + much more detail needed here)

Results

Generic description

Cuticle and epidermis. Cuticle thick to very thick, surface smooth, papillose or striate. Epidermal cell depth 30-115 um, width 15-30(42) um, depth to width ratio 2-5. Outer cell wall moderately to very thick (> 6 um), flat or convex. Anticlinal walls straight; or wavy (rarely), sometimes free form adjacent cells to the depth of the outer cell wall. Stomatal apparatus superficial to sunken. Guard cells with ridges at top and/or bottom. Subsidiary cells' inner portion sometimes bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 25-105 um, width 6-13 um, length to width ratio 2,5-13. Inner peg cell length 25-100 um, width (5)7-11(14) um. Length to width ratio 2,5 - 13. Inner chlorenchyma layer rarely interrupted by sclerenchyma ridges. Lining cells of substomatal chamber either of similar dimensions as peg cells, or extend into inner chlorenchyma layer and/or into epidermal layer. In contact only at ends, or along sides as well, leaving apertures in the inner half of the substomatal tube or intermittently along the sides. Cell ends blunt, pointed or rounded.

Parenchyma sheath. 1 layer of cells, or more than 1 layer at places. Sheath entire, otherwise cells absent or reduced in size outside sclerenchyma ridges. Silica bodies or

granules common in outer layer of sclerenchyma sheath, but occur in various other tissues as well.

Sclerenchyma sheath (3)7-12(18) layers, ridges absent to well defined (extending into chlorenchyma). Fibres differentiated to varying degrees between ridges and areas to the outside of the peripheral vascular bundles . Fibres between peripheral vascular bundles usually narrow with very thick walls, and fibres to the outside of peripheral vascular bundles wider than ridge fibres. Narrow and very thick-walled in outer portion of sheath, wider and with moderately thickened walls at inner portion.

Central ground tissue with central cavity and/or small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a shallow arc, or horseshoe to a deep v-shaped arrangement. Widest tracheids in peripheral vascular bundles at sides, in center of arrangement, or evenly distributed. Medullary vascular bundles with xylem and phloem abutting or separated by a single layer of parenchyma cells. Bundle sheath sclerenchymatous, or consisting of slightly sclerified parenchyma. Outer fibre-caps (1)3-6(7) layers. Inner fibre-caps (0)1-3(6) layers. Medullary vascular bundles dispersed throughout CGT, less frequently confined to outer portion.

Population descriptions

***Cannomois nitida* (Mast.) Pillans W1**

General observations.

Plants caespitose, c. 30 cm tall, occupying a rocky slope (incline of c. 20°) with a northern aspect at an altitude of over 2000 m.

Cuticle and epidermis. Cuticular surface striate. Epidermal cell depth 74.2 um, width 23.6 um, depth to width ratio 3.1. Outer cell wall very thick, flat. Anticlinal walls straight. Stomatal apparatus sunken. Guard cell ridges at top and bottom. Subsidiary cells' inner portion not bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 44.5 um, width 8.85 um, length to width ratio 5.1. Inner peg cell length 44 um, width 8.8 um, length to width ratio 5. Inner chlorenchyma layer not interrupted by sclerenchyma layer. Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer; in contact along sides, leaving apertures in the inner half of the substomatal tube and intermittently along the sides; cell ends pointed.

Parenchyma sheath. 1 layer of cells. Sheath outside sclerenchyma ridges entire. Silica bodies or granules in outer layer of sclerenchyma sheath.

Central ground tissue. Sclerenchyma sheath 4-5 layers.

Ridges absent. Fibres homogenous throughout sheath (or almost so). Fibres between peripheral vascular bundles with

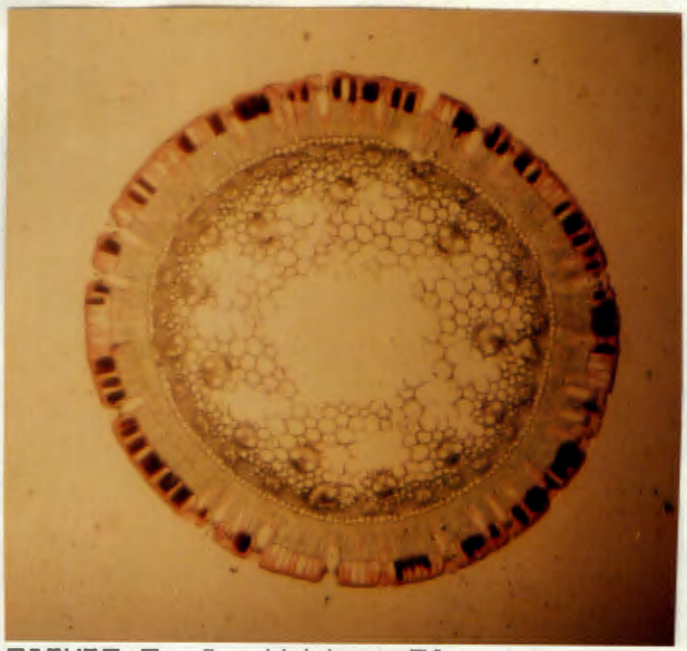

FIGURE 3. *C.nitida* x 50

moderately thick walls. Fibres to the outside of peripheral vascular bundles of similar dimensions as ridge fibres and with larger lumina than ridge fibres. Central ground tissue with central cavity (in some culms). Xylem tracheids in peripheral vascular bundles arranged in a deep horseshoe. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with phloem abutting on xylem. Bundle sheath parenchymatous. Outer fibre-caps present, 1-3 layers. Inner fibre-caps present (mostly), 1 layer; or absent. Medullary vascular bundles confined to outer portions.

Cannomois parviflora **(Thunb.) Pillans W4**

General observations

Plants caespitose, far apart, 90 cm tall and 1-2 m in diameter. Culms infrequently branched. Rhizomes interwoven through repeated branching.

Cuticle and epidermis. Cuticular surface smooth to striate. Epidermal cell depth 42.9 um, width 24.2 um, depth to width ratio 1.8. Outer cell wall moderately thick (thick cuticle), convex. Anticlinal walls straight. Stomatal apparatus superficial to slightly sunken. Guard cell ridges at top and bottom. Subsidiary cells' inner portion not bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 36.8 um, width 8.6 um, length to width ratio 4.3. Inner peg cell length 40 um, width 7.8 um, length to width ratio 5.1. Inner chlorenchyma layer interrupted by sclerenchyma layer. Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer (rarely); or to top of inner chlorenchyma layer. In contact near inner and outer ends only to along sides, leaving apertures in the inner half of the substomatal tube. Cell ends blunt.

Parenchyma sheath. 1 layer of cells. Sheath outside sclerenchyma ridges absent. Silica bodies or granules in outer layer of sclerenchyma sheath (on ridges).

Central ground tissue. Sclerenchyma sheath 7-9 layers (13/14 at ridges), ridges well defined, extending into

chlorenchyma. Fibres homogenous throughout sheath (or almost so) and narrow and very thick-walled in outer portion of sheath, wider and with moderately thickened walls at inner portion. Fibres between peripheral vascular bundles with moderately thick walls. Fibres to the outside of peripheral vascular bundles of similar dimensions as ridge fibres. Central ground tissue with central cavity. Xylem tracheids in peripheral vascular bundles arranged in a shallow arc. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath sclerenchymatous. Outer fibre-caps present, 4 or 5 layers. Inner fibre-caps present, 2 or 3 layers. Medullary vascular bundles confined to outer portions (mostly embedded in sclerenchyma sheath).

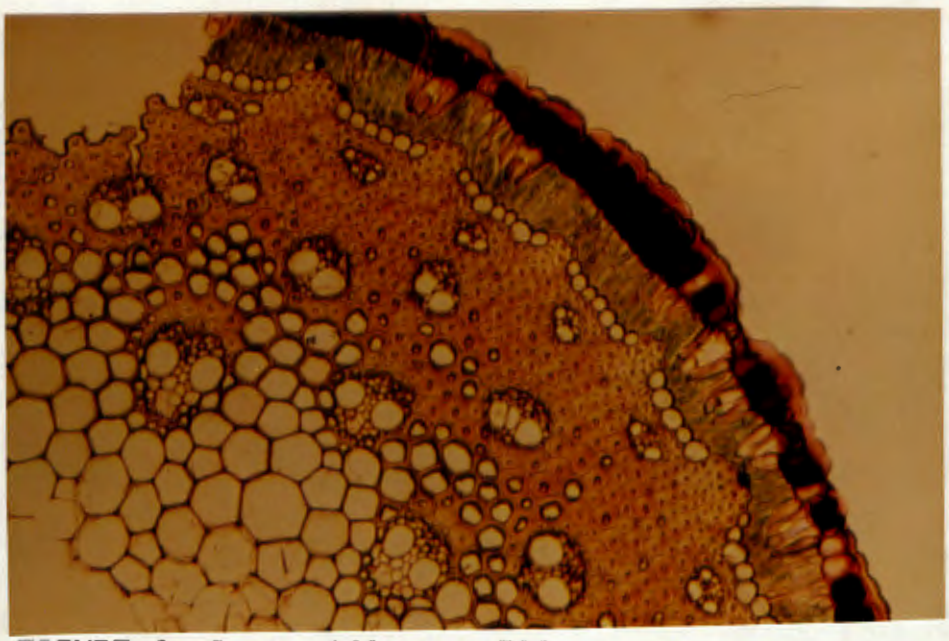

FIGURE 4. *C.parviflora* x 200

Cannomois parviflora (Thunb.) Pillans W8

General observations

Plants growing on a very rocky ridge with a W aspect, protected from fire. Tussocks wedged between rocks, c. 1m high. Rhizomatous rootstock, matted. Plants relatively old, culms not branched at all. Female inflorescences bearing 3-6 spikelets.

Cuticle and epidermis. Cuticular surface papillose. Epidermal cell depth 65 um, width 24.2 um, depth to width ratio 2.7. Outer cell wall moderately thick, flat. Anticlinal walls straight. Stomatal apparatus superficial, guard cell ridges at bottom. Subsidiary cells' inner portion bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 36.1 um, width 7 um, length to width ratio 5.2. Inner peg cell length 35 um, width 8 um, length to width ratio 4.4.

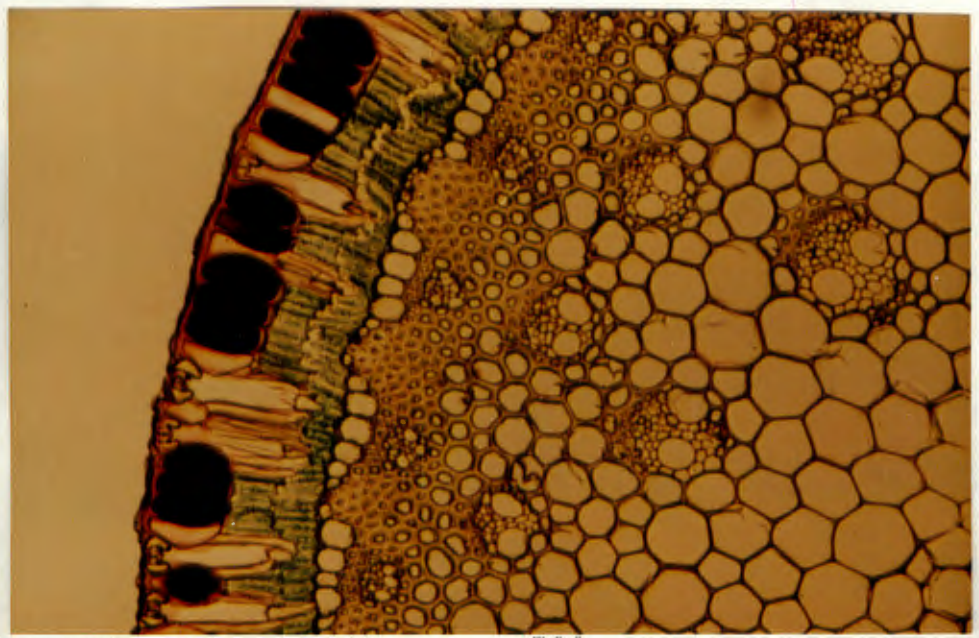

FIGURE 5. *C.parviflora* x 200

Inner chlorenchyma layer not interrupted by sclerenchyma ridges. Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer. In contact along sides, leaving apertures in the inner half of the substomatal tube. Cell ends rounded.

Parenchyma sheath. More than 1 layer of cells in places. Sheath outside sclerenchyma ridges absent or reduced in cell size. Silica bodies or granules in outer layer of sclerenchyma sheath.

Central ground tissue. Sclerenchyma sheath 6-8 layers with slight ridges. Fibres narrow and very thick-walled in outer portion of sheath, wider and with moderately thickened walls at inner portion and differentiated between ridges and areas to the outside of the peripheral vascular bundles (slightly). Fibres between peripheral vascular bundles with moderately thick walls. Fibres to the outside of peripheral

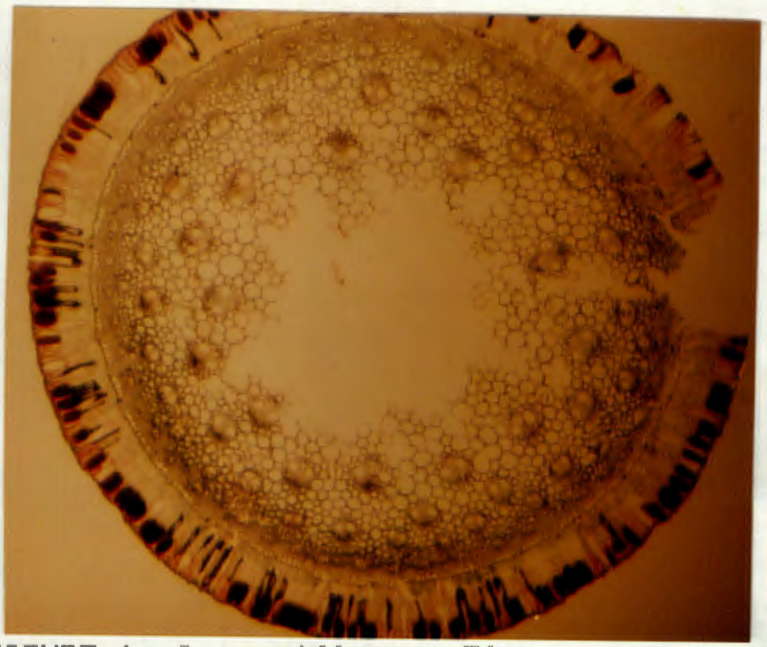

FIGURE 6. *C.parviflora* x 50

vascular bundles with larger lumina than ridge fibres. Central ground tissue with central cavity. Xylem tracheids in peripheral vascular bundles arranged in a deep horseshoe. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath parenchymatous. Outer fibre-caps present, 2-4 layers. Inner fibre-caps present. 1 or 2 layers. Medullary vascular bundles confined to outer portions.

***Cannomois parviflora* (Thunb.) Pillans W9**

General observations

Plants c. 40 cm tall, growing more or less widely spaced or forming dominant stands over large areas on a flat sandy plain which was recently burnt, so that all the plants were very young. 1/2 spikelets per inflorescence. Rhizomes compact.

Cuticle and epidermis. Cuticular surface papillose. Epidermal cell depth 84.3 um, width 25.7 um, depth to width ratio 3.3. Outer cell wall very thick, flat. Anticlinal walls straight. Stomatal apparatus superficial. Guard cell ridges at top and bottom. Subsidiary cells' inner portion not bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 69.1 um, width 8.1 um, length to width ratio 8.5.

Inner peg cell length 68.2 um, width 6.8 um, length to width ratio 10. Inner chlorenchyma layer not interrupted by

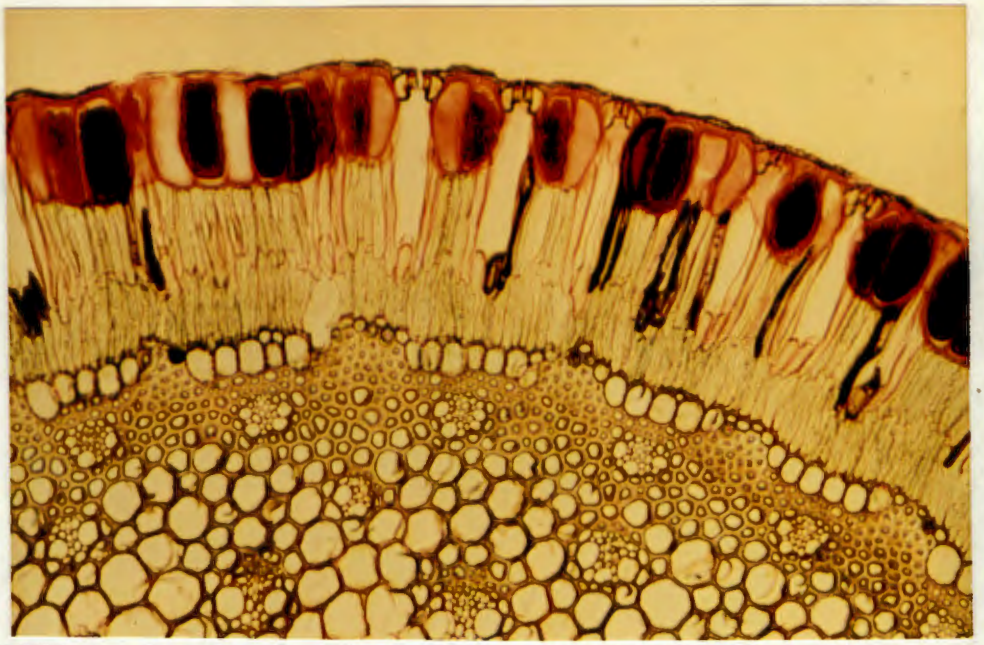

FIGURE 7. *C.parviflora* x 200

sclerenchyma layer. Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer and into epidermal layer (halfway). In contact intermittently along the sides. Cell ends rounded.

Parenchyma sheath. 1 layer of cells. Sheath outside sclerenchyma ridges absent; or reduced in cell size. Silica bodies or granules in outer layer of sclerenchyma sheath.

Central ground tissue. Sclerenchyma sheath 5-7 layers (9-11 at ridges). Sclerenchyma ridges slight. Fibres homogenous throughout sheath (or almost so) and narrow and very thick-walled in outer portion of sheath, wider and with moderately thickened walls at inner portion. Fibres between peripheral vascular bundles with moderately thick walls. Fibres to the

outside of peripheral vascular bundles wider than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a deep horseshoe. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath parenchymatous. Outer fibre-caps present, 2-3 layers. Inner fibre-caps present, 1 or 2 layers. Medullary vascular bundles confined to outer portions.

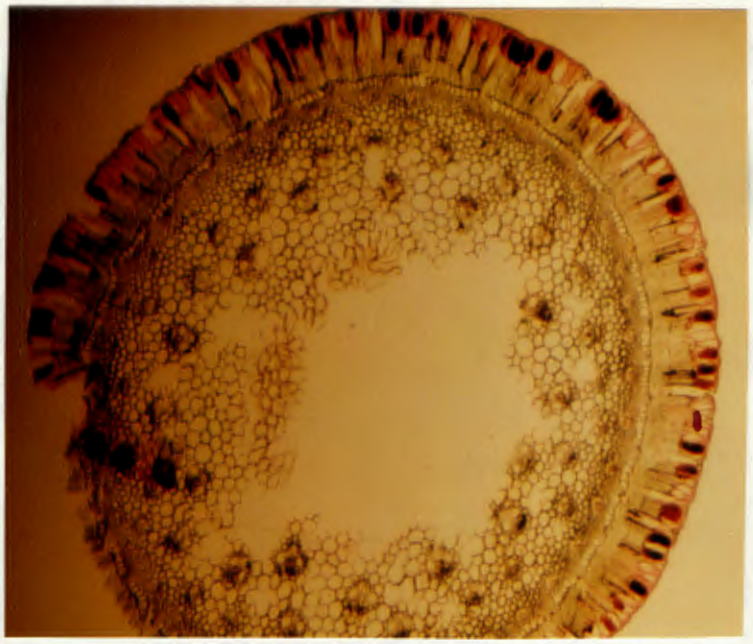

FIGURE 8. *C.parviflora* x 50.

***Cannomois taylorii* (sp. nov.) W5**

General observations

Plants form large mats (or "reed-beds") among rocks. Culms c. 1,8 m tall. Rhizomes straight, infrequently branching and spreading. Culms wide apart on rhizomes.

Cuticle and epidermis. Cuticular surface smooth. Epidermal cell depth 77.2 um, width 21.8 um, depth to width ratio 3.5. Outer cell wall very thick (thick cuticle), flat (cell ends separated to depth of outer cell wall). Anticlinal walls wavy. Stomatal apparatus superficial (high density of stomata). Guard cell ridges at top and bottom. Subsidiary

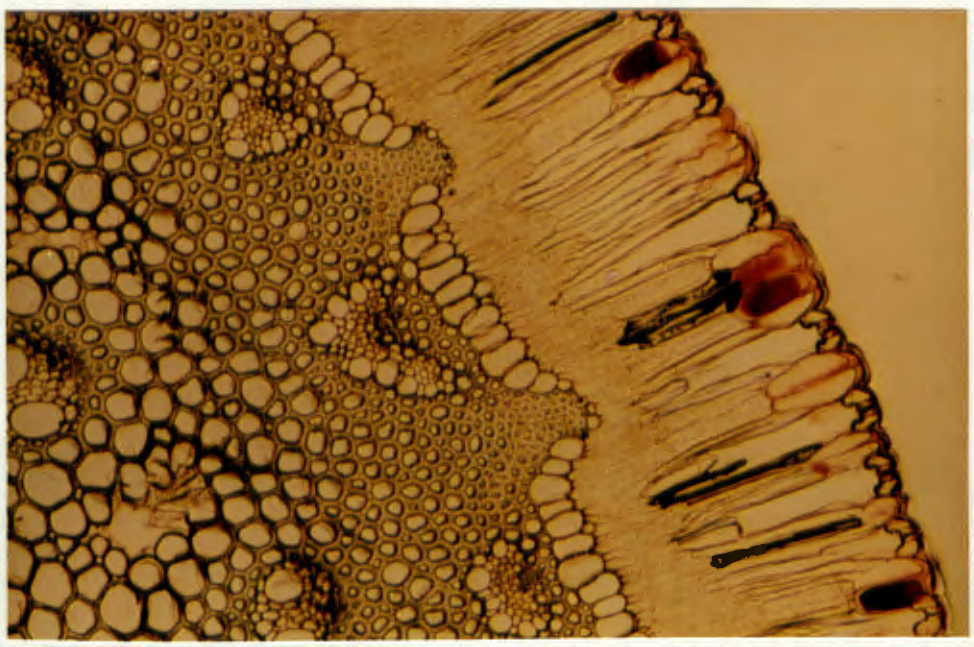

FIGURE 9. *C.taylorii* (sp. nov.) x 200

cells' inner portion not bulbous (outer lip present).

Chlorenchyma layer. Chlorenchyma peg cell length (outer

layer) 96.2 um, width 7.1 um, length to width ratio 13.5. Inner peg cell length 83.2 um, width 7.8 um, length to width ratio 10.7. Inner chlorenchyma layer interrupted by sclerenchyma ridges.Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer and into epidermal layer; in contact along sides, leaving apertures in the inner half of the substomatal tube to intermittently along the sides (by means of pegs). Cell ends pointed.

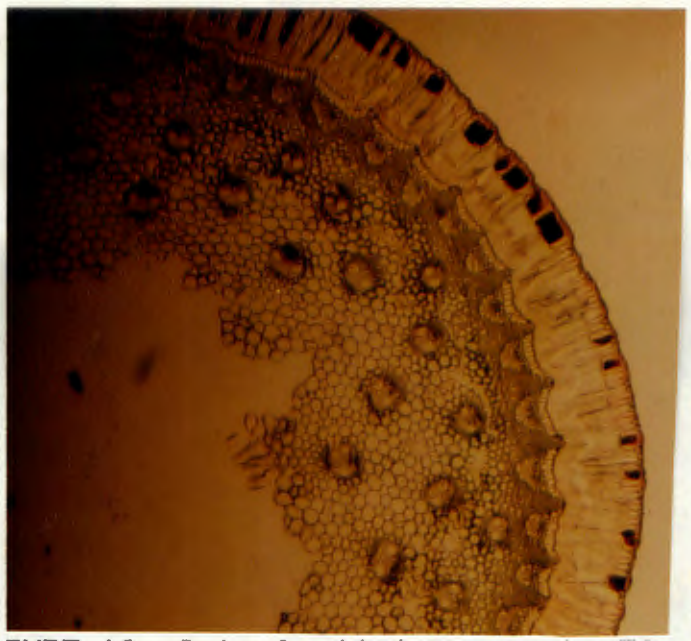

FIGURE 10. *C.taylorii* (sp. nov.) x50

Parenchyma sheath. More than 1 layer of cells in places. Sheath outside sclerenchyma ridges absent. Silica bodies or granules in central ground tissue and in outer layer of sclerenchyma sheath (on ridges).

Central ground tissue. Sclerenchyma sheath 10-13 layers (20-24 at ridges), ridges well defined, extending into chlorenchyma. Fibres differentiated between ridges and areas

to the outside of the peripheral vascular bundles, narrow and very thick-walled in outer portion of sheath, wider and with moderately thickened walls at inner portion. Fibres between peripheral vascular bundles narrow with very thick walls. Fibres to the outside of peripheral vascular bundles wider than ridge fibres. Central ground tissue with small cavities dispersed between vascular bundles, central cavity absent or caused by mechanical tearing. Xylem tracheids in peripheral vascular bundles arranged in a shallow arc to v-shaped. Widest tracheids in peripheral vascular bundles in center of arrangement (at inner pole of bundle). Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath sclerenchymatous. Outer fibre-caps present. 3-5 layers. Inner fibre-caps present. 2 layers; or 3 layers. Medullary vascular bundles dispersed throughout CGT.

***Cannomois taylorii* (sp. nov.) W7**

General observations

Rocky, semi-arid habitat (arid fynbos with *Passerina, Protea, Crassula*, mesembs, *Metalasia* and *Phylica*).Plants form stands c. 3 m in diameter due to the spreading rhizomatous rootstock.

Cuticle and epidermis. Cuticular surface smooth. Epidermal cell depth 62.8 um, width 20.6 um, depth to width

ratio 3. Outer cell wall very thick, flat. Anticlinal walls straight; or wavy (rarely). Stomatal apparatus superficial to slightly sunken. Guard cell ridges at top and bottom. Subsidiary cells' inner portion not bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 58.2 um, width 9.1 um, length to width ratio 6.4. Inner peg cell length 60.7 um, width 7.5 um. Length to width ratio 8.1. Inner chlorenchyma layer interrupted by sclerenchyma ridges.Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer and into epidermal layer. In contact along sides, leaving apertures in the inner half of the substomatal tube; or intermittently

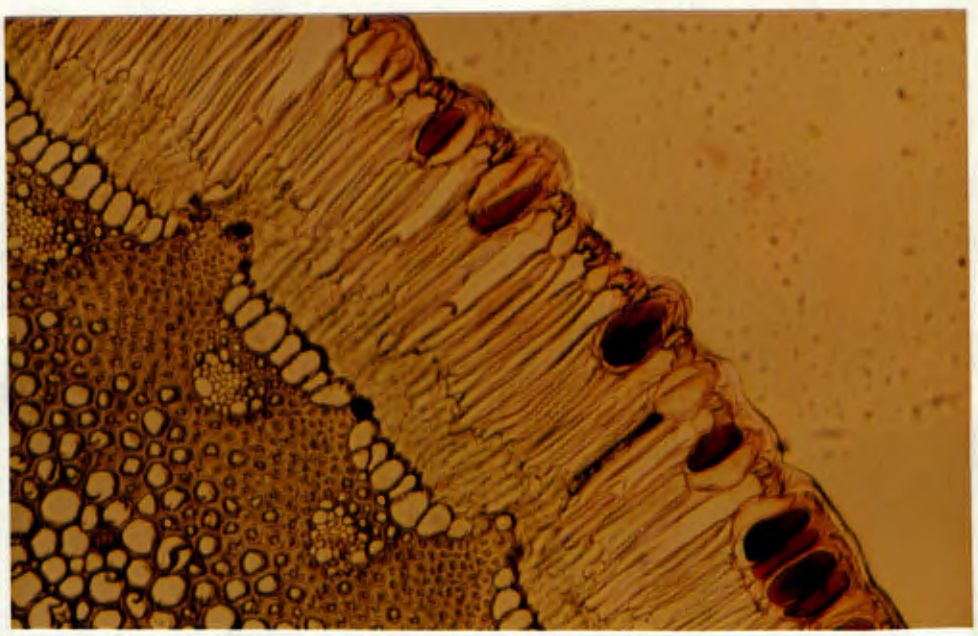

FIGURE 11. *C.taylorii* (sp. nov.) x 200

along the sides. Cell ends blunt.

Parenchyma sheath. 1 layer of cells. Sheath outside sclerenchyma ridges absent. Silica bodies or granules in

outer layer of sclerenchyma sheath.

Central ground tissue. Sclerenchyma sheath 8-11 layers, ridges well defined, extending into chlorenchyma. Fibres differentiated between ridges and areas to the outside of the peripheral vascular bundles and narrow and very thick-walled in outer portion of sheath, wider and with moderately thickened walls at inner portion. Fibres between peripheral vascular bundles narrow with very thick walls. Fibres to the outside of peripheral vascular bundles wider than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a shallow arc to v-shaped arrangement. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and

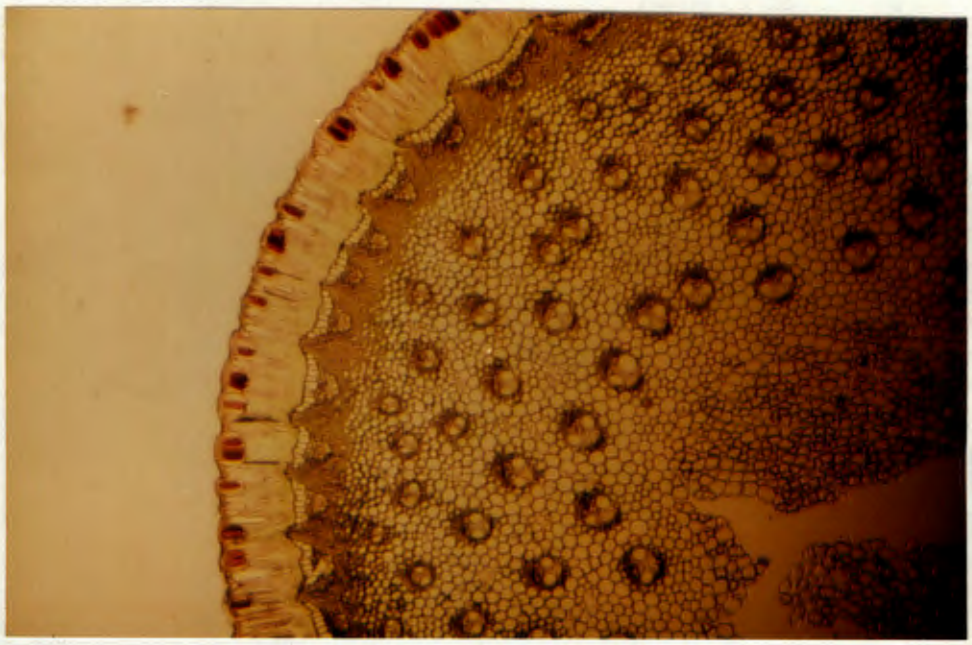

FIGURE 12. *C.taylorii* x 50

phloem separated by parenchyma cells. Bundle sheath

sclerenchymatous. Outer fibre-caps present, 4 or 5 layers. Inner fibre-caps present. 2 or 3 layers. Medullary vascular bundles dispersed throughout CGT.

***Cannomois aristata* Mast. W10**

General observations

Plants 40-50cm tall, initially tuft-forming, soon sending out spreading rhizomes, the remains of which are very conspicuous in the burnt areas running more or less unbranched across the ground. Plants occupy sandy patches among rocks.

Cuticle and epidermis. Cuticular surface smooth to papillose (slightly). Epidermal cell depth 106.6 um, width 36.3 um, depth to width ratio 2.9. Outer cell wall moderately thick, flat. Anticlinal walls straight; or wavy (infrequent).

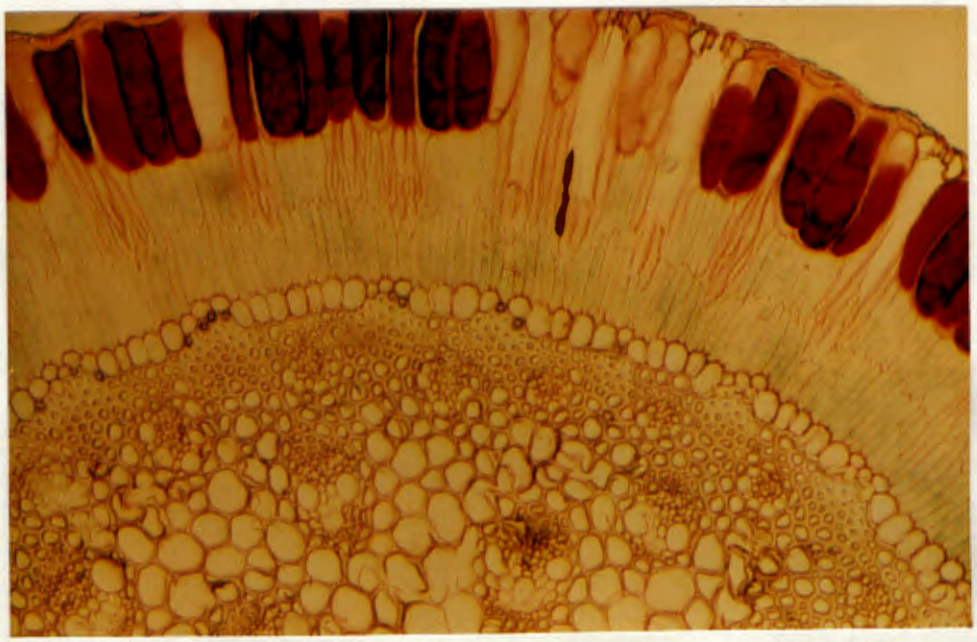

FIGURE 13. *C.aristata* x 200

Stomatal apparatus superficial. Guard cell ridges at top and bottom (both prominent). Subsidiary cells' inner portion not bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 63.6 um, width 9.6 um, length to width ratio 6.6. Inner peg cell length 67 um, width 8 um, length to width ratio 8. Inner chlorenchyma layer not interrupted by sclerenchyma ridges.Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer and into epidermal layer. In contact along sides, leaving apertures in the inner half of the substomatal tube; or intermittently along the sides. Cell ends rounded.

Parenchyma sheath. 1 layer of cells. Sheath outside sclerenchyma ridges reduced in cell size. Silica bodies or granules in outer layer of sclerenchyma sheath and associated with inner sclerenchyma caps of medullary vascular bundles.

Central ground tissue. Sclerenchyma sheath 3-7 layers. Ridges slight. Fibres differentiated between ridges and areas to the outside of the peripheral vascular bundles. Fibres between peripheral vascular bundles with moderately thick walls. Fibres to the outside of peripheral vascular bundles wider than ridge fibres. Central ground tissue with central cavity and small cavities (infrequent) between vascular bundles Xylem tracheids in peripheral vascular bundles arranged in a shallow arc. Widest tracheids in peripheral vascular bundles in center of arrangement. Medullary vascular bundles with xylem and phloem separated by parenchyma cells.

Bundle sheath parenchymatous. Outer fibre-caps present. 1-3 layers. Inner fibre-caps present; or absent (rarely). 1 or 2

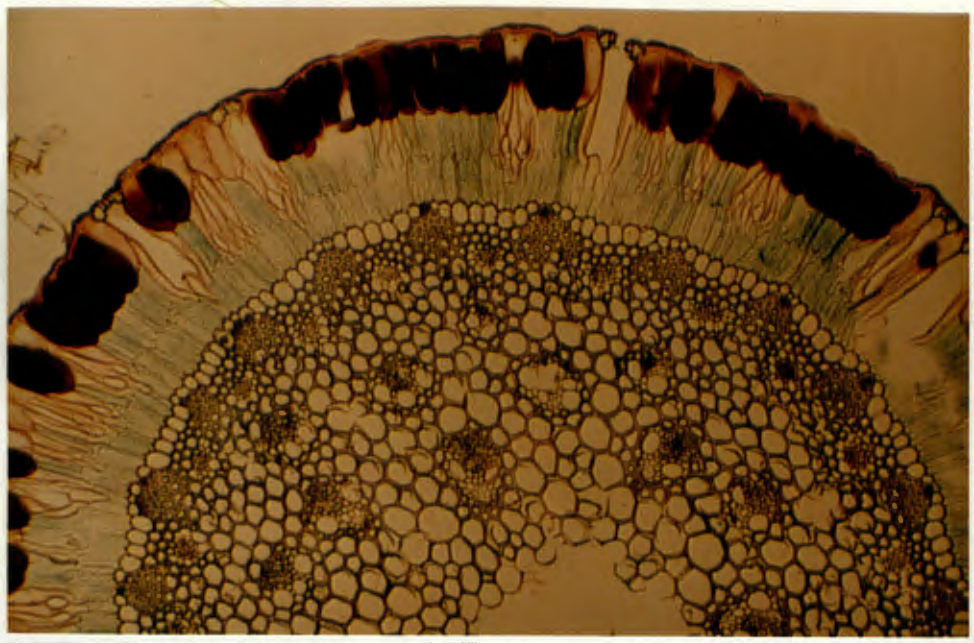

FIGURE 14. *C.aristata* x 125

layers. Medullary vascular bundles dispersed throughout CGT.

***Cannomois virgata* (Rottb.) Steud. W2**

General observations.

Plants growing in spaced tussocks; 1,7-1,8 m tall at an altitude of c. 1250 m. Rhizomes have a compact organization with many, closely packed vegetative stems arising from it, and a strong tendency to branch.

Cuticle and epidermis. Cuticular surface striate.

Epidermal cell depth 55.9 um, width 22.1 um, depth to width ratio 2.5. Outer cell wall moderately thick, flat. Anticlinal walls straight. Stomatal apparatus superficial. Guard cell ridges at top and bottom. Subsidiary cells' inner portion not bulbous (outer surface forms lip).

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 32.4 um, width 11.33 um, length to width ratio 2.9. Inner peg cell length 35.1 um, width 10.7 um, length to width ratio 3.3.Inner chlorenchyma layer not interrupted by sclerenchyma layer. Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer and into epidermal layer; in contact near inner and outer ends only, or along sides, leaving apertures in the inner half of the substomatal tube. Cell ends rounded.

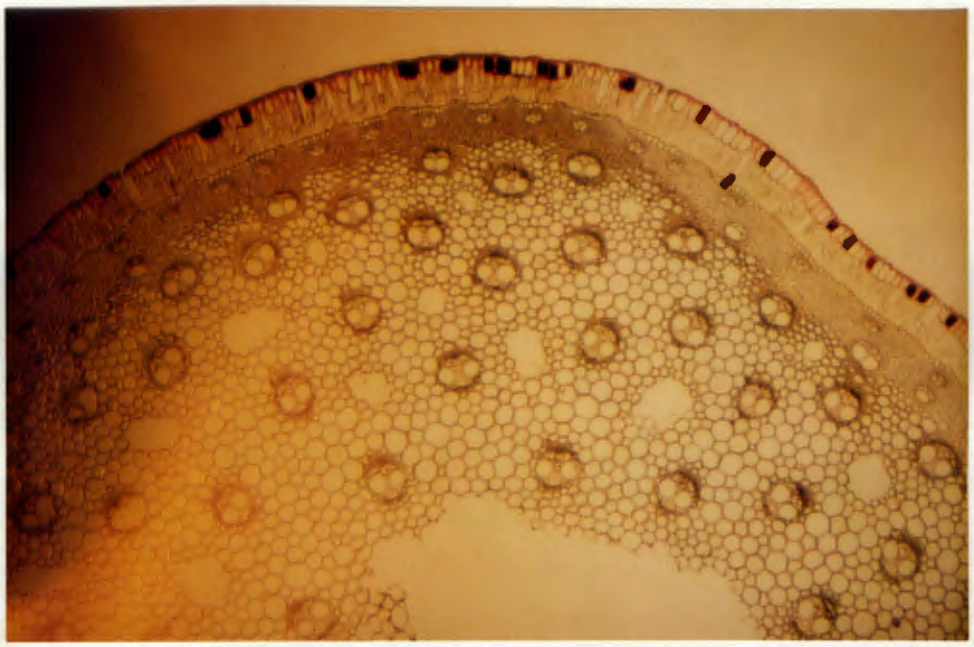

FIGURE 15. *C.virgata* x 200

Parenchyma sheath. 1 layer of cells. Sheath outside

sclerenchyma ridges reduced in cell size, or absent (sometimes). Silica bodies or granules in outer layer of sclerenchyma sheath.

Central ground tissue. Sclerenchyma sheath 9-18 layers, with slight ridges. Fibres homogenous throughout sheath (or almost so) to differentiated between ridges and areas to the outside of the peripheral vascular bundles (slightly). Fibres between peripheral vascular bundles with moderately thick walls. Fibres to the outside of peripheral vascular bundles wider than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a shallow arc. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath sclerenchymatous or parenchymatous. Outer fibre-caps present, 4-6 layers. Inner fibre-caps present, 2 or 3 layers. Medullary vascular bundles dispersed throughout CGT. Single ring of fibres separating central cavity from rest of CGT present (in some specimens).

Cannomois virgata **(Rottb.) Steud. W6**

General observations

Plants widely spaced, 2 m tall, growing in a watercourse

along with *Stoebe plumosa*. Compact rhizome.

Cuticle and epidermis. Cuticular surface striate. Epidermal cell depth 44.5 um, width 24.2 um, depth to width ratio 1.8. Outer cell wall moderately thick, flat. Anticlinal walls straight. Stomatal apparatus superficial or slightly sunken. Guard cell ridges at top and bottom. Subsidiary cells' inner portion bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 45.3, width 8.9 um, length to width ratio 5.1. Inner peg cell length 40.8 um, width 10.9 um, length to width ratio 3.7. Inner chlorenchyma layer interrupted by sclerenchyma layer (at places). Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer. In contact along sides, leaving apertures in the inner half of the substomatal tube. Cell ends blunt.

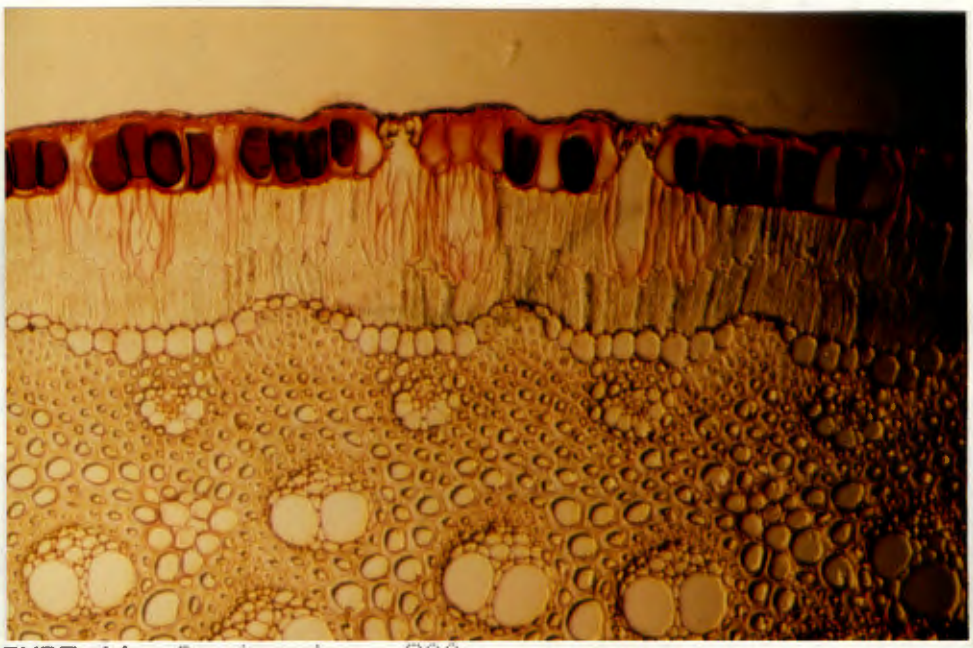

FIGURE 16. *C.virgata* x 200

Parenchyma sheath. 1 layer of cells. Sheath outside sclerenchyma ridges absent; or reduced in cell size. Silica bodies or granules in parenchymatous sheath and in outer layer of sclerenchyma sheath.

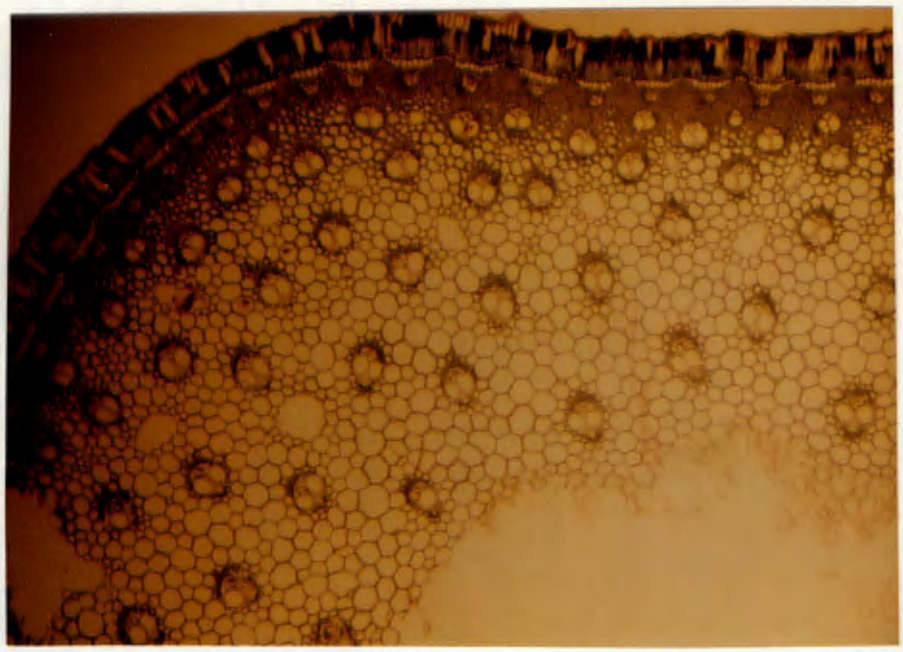

FIGURE 17. *C.virgata* x 50

Central ground tissue. Sclerenchyma sheath 7-12 layers, with slight ridges. Fibres differentiated between ridges and areas to the outside of the peripheral vascular bundles. Fibres between peripheral vascular bundles narrow with very thick walls. Fibres to the outside of peripheral vascular bundles wider than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a shallow arc. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with

xylem and phloem separated by parenchyma cells. Bundle sheath parenchymatous. Outer fibre-caps present. 4-6 layers. Inner fibre-caps present. 1-3 layers. Medullary vascular bundles dispersed throughout CGT.

***Cannomois virgata* (Rottb.) Steud. W11**

General observations

Plants up to 4m tall, growing along steep sides of a seasonal watercourse, among *Leucadendron eucalyptifolium* Culms c. 3cm in diameter at base.

Cuticle and epidermis. Cuticular surface striate (epidermal surface very irregular due to variation in cell height). Epidermal cell depth 39.8 um, width 22.3 um, depth

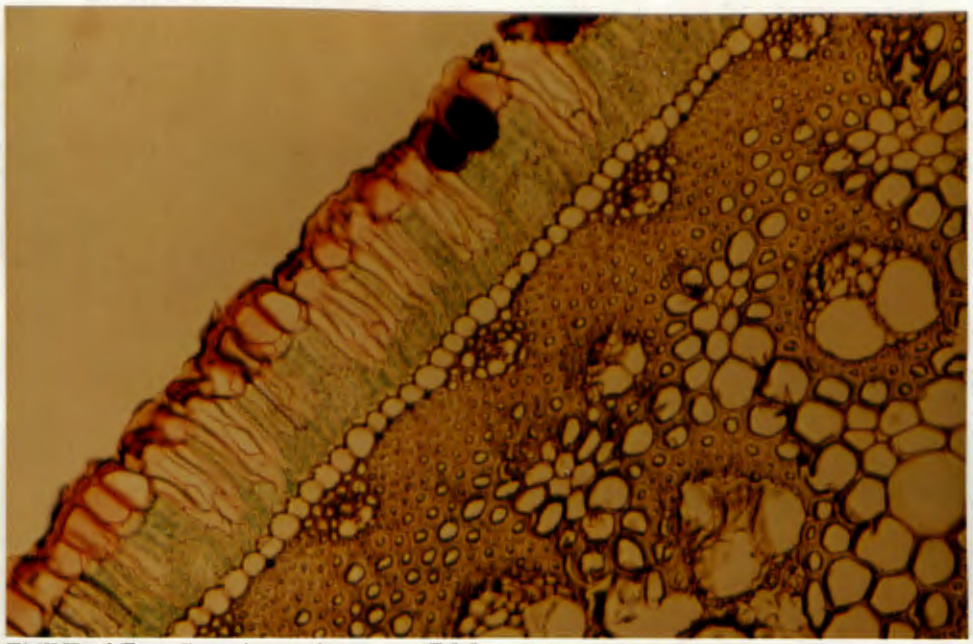

FIGURE 18. *C.virgata* x 200

to width ratio 1.8. Outer cell wall moderately thick, convex (mostly). Anticlinal walls straight. Stomatal apparatus superficial. Guard cell ridges at top and bottom (both prominent). Subsidiary cells' inner portion not bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 58.2 um, width 6.7 um, length to width ratio 8.6. Inner peg cell length 50 um, width 7.7 um, length to width ratio 6.5. Inner chlorenchyma layer not interrupted by sclerenchyma ridges.Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer and into epidermal layer. In contact along sides, leaving apertures in the inner half of the substomatal tube. Cell ends pointed.

Parenchyma sheath. 1 layer of cells. Sheath outside sclerenchyma ridges entire to slightly reduced in cell size Silica bodies or granules in outer layer of sclerenchyma sheath and associated with inner sclerenchyma caps of medullary vascular bundles.

Central ground tissue. Sclerenchyma sheath 9-15 layers. Ridges absent. Fibres differentiated between ridges and areas to the outside of the peripheral vascular bundles. Fibres between peripheral vascular bundles with moderately thick walls. Fibres to the outside of peripheral vascular bundles wider than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a deep horseshoe. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and

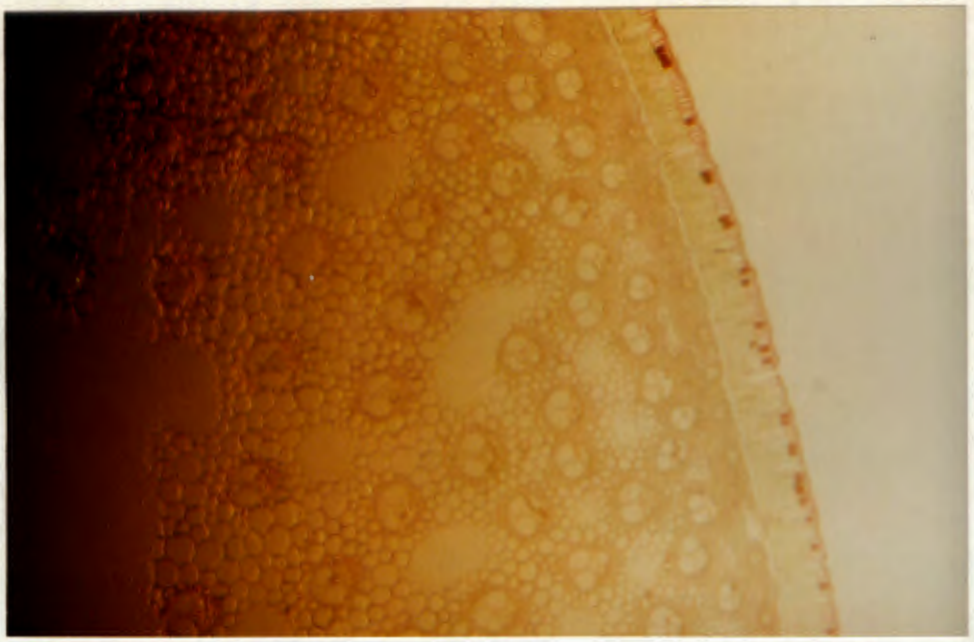

FIGURE 19. *C.virgata* x 50

phloem separated by parenchyma cells. Bundle sheath sclerenchymatous. Outer fibre-caps present. 4-7 layers. Inner fibre-caps present. 2-4 layers. Medullary vascular bundles dispersed throughout CGT.

Cannomois virgata **(Rottb.) Steud. W16**

General observations

Plants tall (3-4m), growing in a dense stand along a watercourse.

Cuticle and epidermis. Cuticular surface striate. Epidermal cell depth 48.6 um, width 24 um, depth to width ratio 2. Outer cell wall moderately thick, flat. Anticlinal walls straight. Stomatal apparatus superficial. Guard cell

ridges at top and bottom. Subsidiary cells' inner portion not bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 49 um, width 10 um, length to width ratio 4.9. Inner peg cell length 36.6 um, width 10.1 um, length to width ratio 3.6. Inner chlorenchyma layer not interrupted by sclerenchyma ridges. Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer. In

FIGURE 20. *C.virgata* x 200

contact near inner and outer ends only to along sides, leaving apertures in the inner half of the substomatal tube. Cell ends blunt.

Parenchyma sheath. 1 layer of cells; or more than 1 in places. Sheath outside sclerenchyma ridges reduced in cell size; or entire. Silica bodies or granules in outer layer of sclerenchyma sheath and associated with inner sclerenchyma caps of medullary vascular bundles.

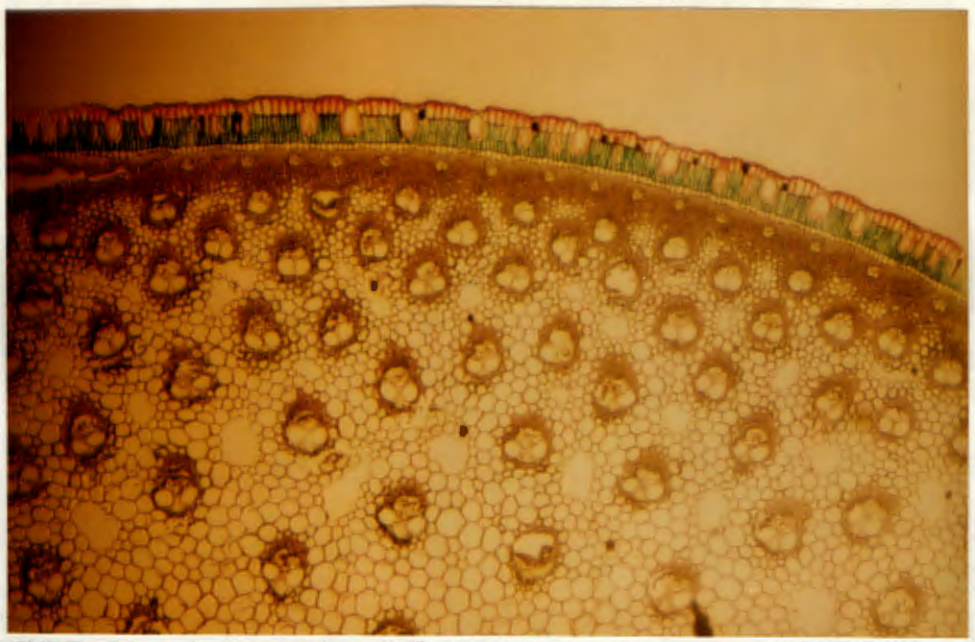

FIGURE 21. *C.virgata* x 50

Central ground tissue. Sclerenchyma sheath 9-15 layers. ridges absent. Fibres differentiated between ridges and areas to the outside of the peripheral vascular bundles. Fibres between peripheral vascular bundles narrow with very thick walls. Fibres to the outside of peripheral vascular bundles wider than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a shallow arc. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath sclerenchymatous. Outer fibre-caps present, 3-6 layers. Inner fibre-caps present, 1 or 2 layers. Medullary vascular bundles dispersed throughout CGT.

***Cannomois virgata* (Rottb.) Steud. W12**

General observations

Plants short (c 1m high), growing on embankment alongside the road. Populations forming almost homogenous stands covering large areas. Rhizomes spreading.

Cuticle and epidermis. Cuticular surface striate. Epidermal cell depth 42.5 um, width 23.5 um, depth to width ratio 1.8. Outer cell wall moderately thick, flat. Anticlinal walls straight. Stomatal apparatus superficial.

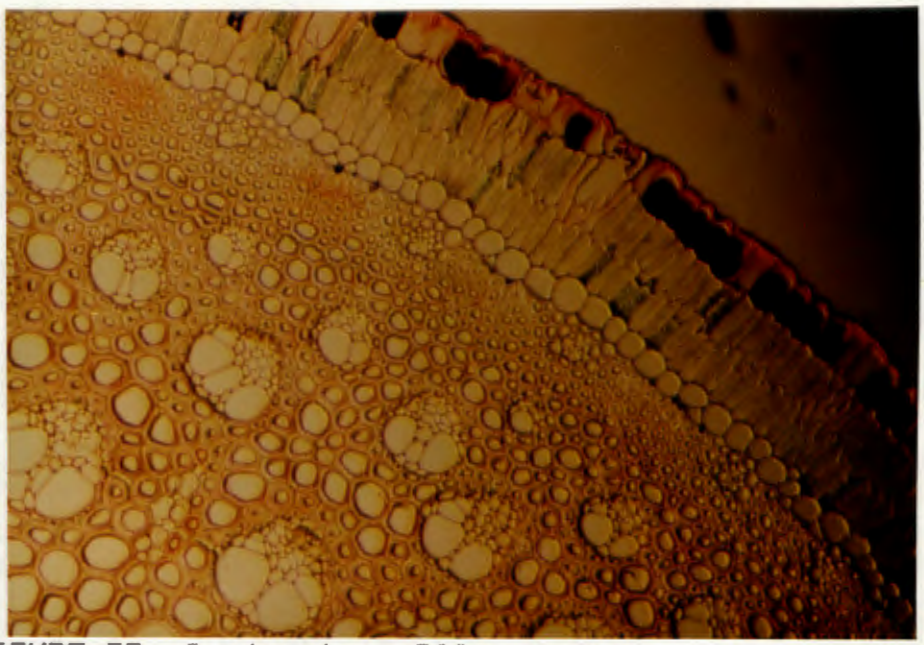

FIGURE 22. *C.virgata* x 200

Guard cell ridges at top and bottom. Subsidiary cells' inner portion not bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 40.9 um, width 9.3 um, length to width ratio 4.4. Inner peg cell length 41.3 um, width 9.3 um, length to width ratio 4.4. Inner chlorenchyma layer not interrupted by

sclerenchyma ridges. Lining cells of substomatal chamber extend to top of inner chlorenchyma layer; or up to halfway into inner chlorenchyma layer. In contact along sides, leaving apertures in the inner half of the substomatal tube. Cell ends pointed.

Parenchyma sheath. More than 1 layer of cells in places. Sheath outside sclerenchyma ridges entire. Silica bodies or granules in parenchymatous sheath and in outer layer of sclerenchyma sheath.

Central ground tissue. Sclerenchyma sheath 9-12 layers. Ridges absent. Fibres differentiated between ridges and areas

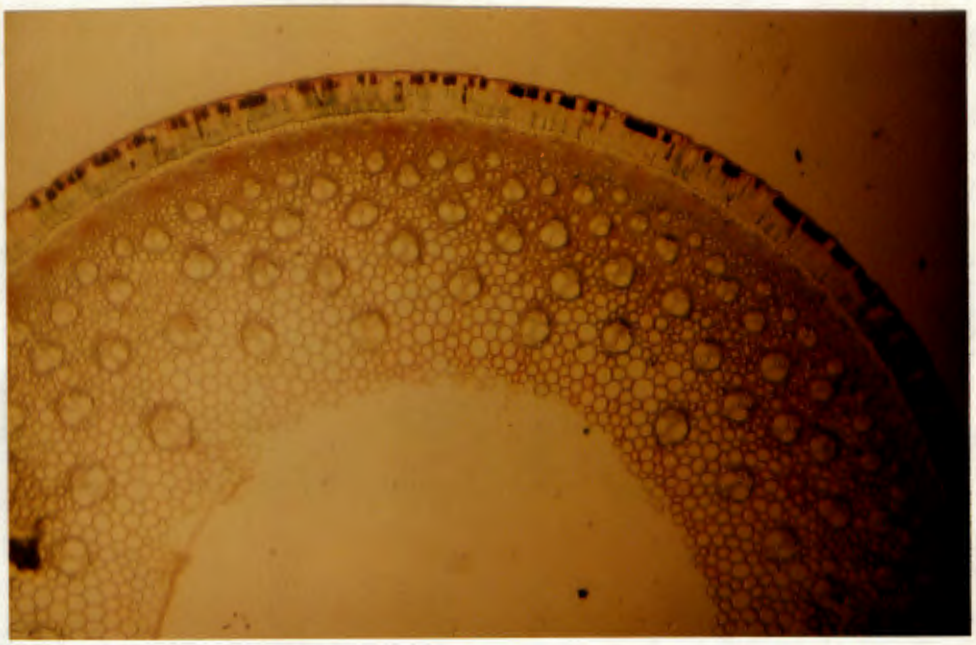

FIGURE 23. *C.virgata* x 50

to the outside of the peripheral vascular bundles. Fibres between peripheral vascular bundles with moderately thick walls. Fibres to the outside of peripheral vascular bundles wider than ridge fibres. Central ground tissue with central cavity. Xylem tracheids in peripheral vascular bundles

arranged in a shallow arc. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath sclerenchymatous. Outer fibre-caps present, 1-5 layers. Inner fibre-caps present, 1-5 layers. Medullary vascular bundles dispersed throughout CGT. Single ring of fibres separating central cavity from rest of CGT absent (ring of sclerified parenchyma cells).

***Cannomois virgata* (Rottb.) Steud. W13**

General observations

Plants short (c.1,5 m), growing on open south facing slope.

Cuticle and epidermis. Cuticular surface striate. Epidermal cell depth 41.5 um, width 21.5 um, depth to width ratio 1.9. Outer cell wall moderately thick, flat to convex. Anticlinal walls straight. Stomatal apparatus slightly sunken. Guard cell ridges at top and bottom. Subsidiary cells' inner portion not bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 31 um, width 9.7 um, length to width ratio 3.2. Inner peg cell length 36.5 um, width 10.3 um, length to width ratio 3.5. Inner chlorenchyma layer not interrupted by sclerenchyma ridges.Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer,and into

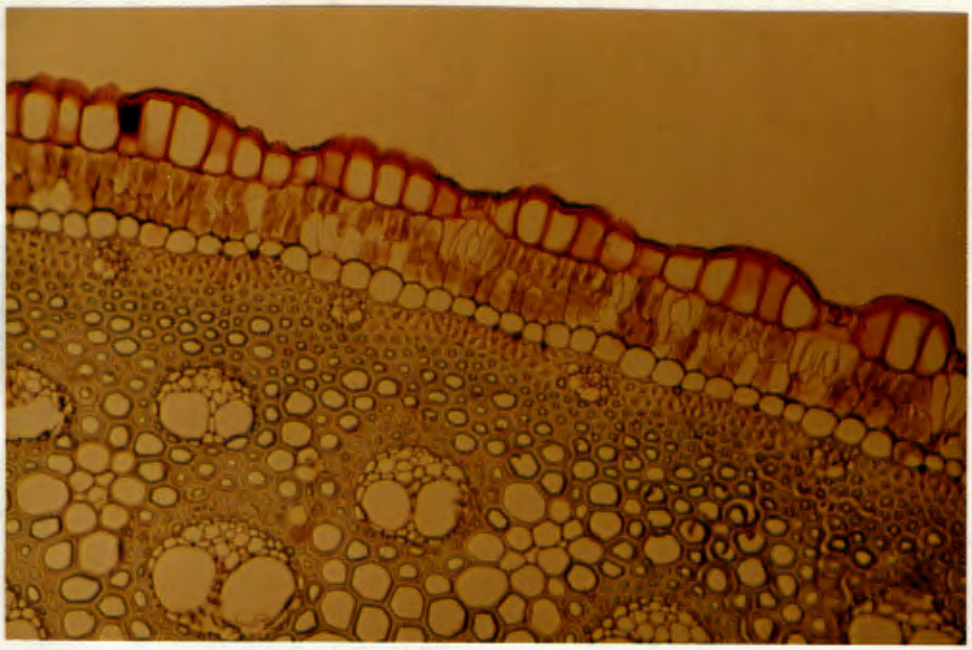

FIGURE 24. *C.virgata* x 200

epidermal layer. In contact along sides, leaving apertures in the inner half of the substomatal tube; or intermittently along the sides. Cell ends blunt.

Parenchyma sheath. 1 layer of cells to more than 1 layer of cells in places (infrequent). Sheath outside sclerenchyma ridges slightly reduced in cell size or entire. Silica bodies or granules (frequent) in outer layer of sclerenchyma sheath, associated with inner sclerenchyma caps of medullary vascular bundles, in central ground tissue, and in epidermal and peg cells.

Central ground tissue. Sclerenchyma sheath 7-12 layers. Ridges absent to slight. Fibres differentiated between ridges and areas to the outside of the peripheral vascular bundles. Fibres between peripheral vascular bundles narrow with very thick walls (radially compressed). Fibres to the outside of

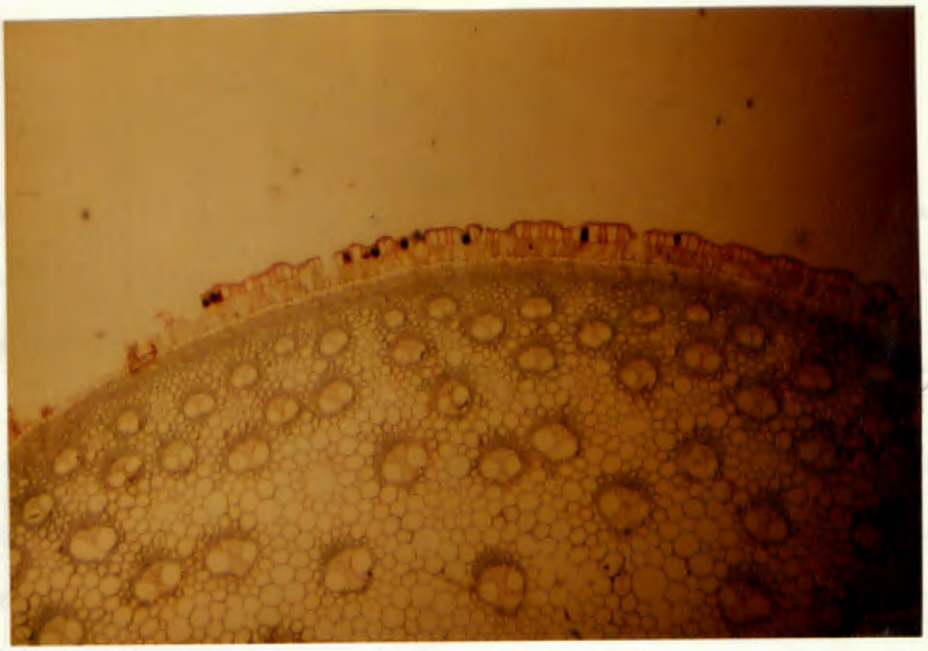

FIGURE 25. *C.virgata* x 50

peripheral vascular bundles wider than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a deep horseshoe. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath sclerenchymatous. Outer fibre-caps present. 3-7 layers. Inner fibre-caps present, 2 or 3 layers. Medullary vascular bundles dispersed throughout CGT.

ratio 2.6. Inner chlorenchyma layer not interrupted by sclerenchyma layer. Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer and into epidermal layer. In contact near inner and outer ends only, or along sides, leaving apertures in the inner half of the substomatal tube. Cell ends rounded.

Parenchyma sheath. 1 layer of cells. Sheath outside sclerenchyma ridges reduced in cell size (sometimes 1 cell replaced by Si granule). Silica bodies or granules in parenchymatous sheath and in outer layer of sclerenchyma sheath.

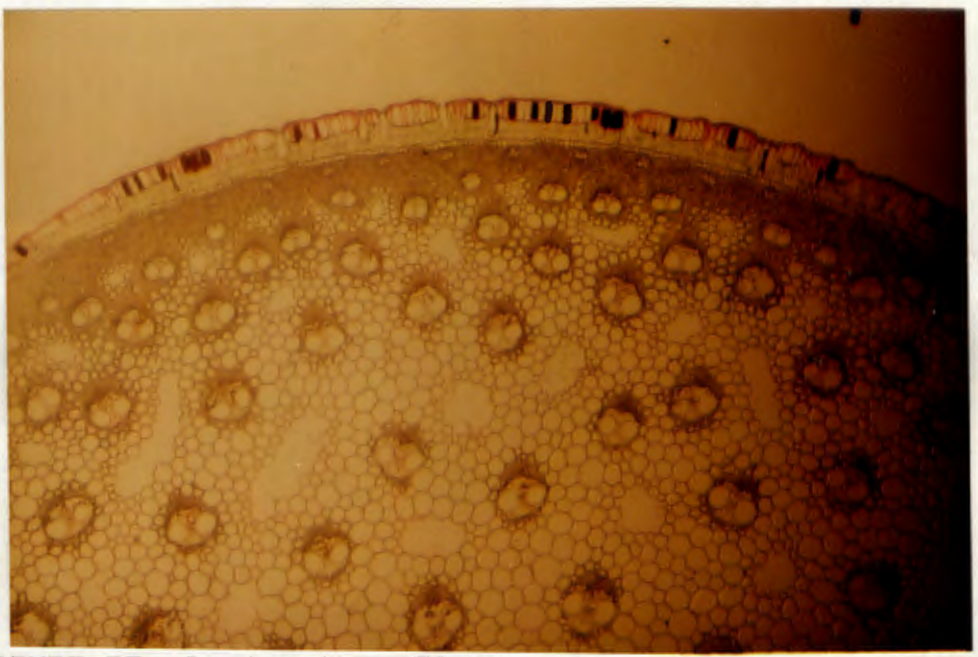

FIGURE 27. *C.virgata* x 50

Central ground tissue. Sclerenchyma sheath 9-13 layers, ridges absent. Fibres homogenous throughout sheath (or almost so) and narrow and very thick-walled in outer portion of sheath, wider and with moderately thickened walls at inner

portion. Fibres between peripheral vascular bundles with moderately thick walls. Fibres to outside of peripheral vascular bundles with larger lumina than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a shallow arc. Widest tracheids in peripheral vascular bundles at sides. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath sclerenchymatous and parenchymatous (innermost vascular bundles). Outer fibre-caps present. 5-8 layers (usually 6). Inner fibre-caps present, 3-6 layers. Medullary vascular bundles dispersed throughout CGT.

***Cannomois virgata-scirpoides* intermediate W14**

General observations

Plants 2-3m tall, showing much variation at the site, regarding culm branching and tepal dimensions relative to the fruits.

Cuticle and epidermis. Cuticular surface smooth to slightly papillose Epidermal cell depth 54 um, width 23.6 um, depth to width ratio 2.3. Outer cell wall moderately thick, flat. Anticlinal walls straight. Stomatal apparatus superficial. Guard cell ridges at top and bottom. Subsidiary cells' inner portion bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer

layer) 57.4 um, width 8.2 um, length to width ratio 7. Inner peg cell length 55.1 um, width 7.1 um, length to width ratio 7.7. Inner chlorenchyma layer not interrupted by sclerenchyma

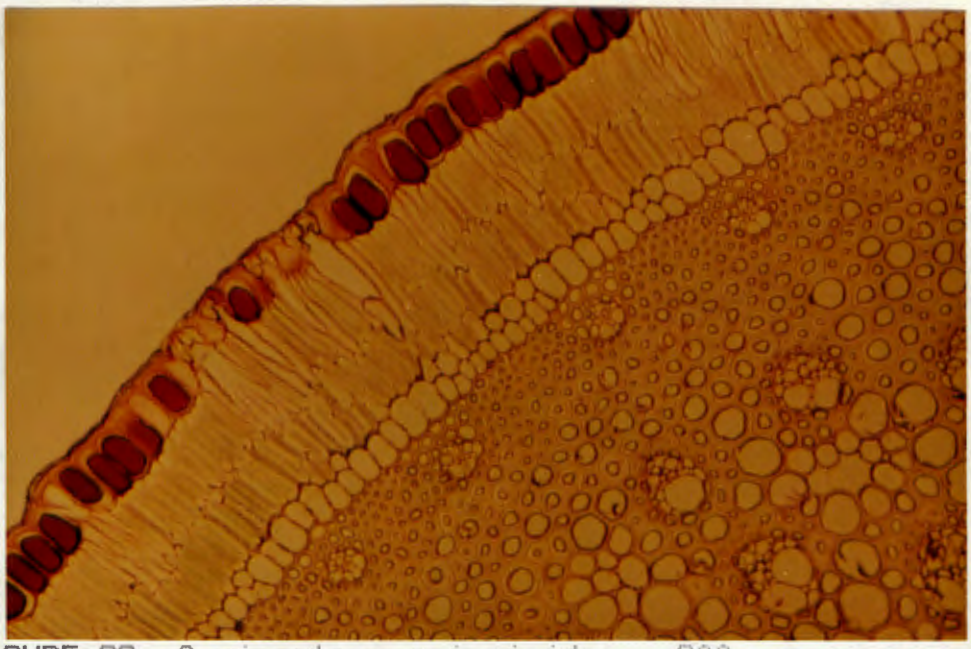

FIGURE 28. *C.virgata x scirpioides* x 200

layer. Lining cells of substomatal chamber extend up to halfway into inner chlorenchyma layer. In contact intermittently along the sides. Cell ends blunt or pointed.

Parenchyma sheath. More than 1 layer of cells in places. Sheath outside sclerenchyma ridges entire. Silica bodies or granules in parenchymatous sheath and in outer layer of sclerenchyma sheath.

Central ground tissue. Sclerenchyma sheath 8-10 layers. Ridges absent. Fibres differentiated between ridges and areas to the outside of the peripheral vascular bundles. Fibres between peripheral vascular bundles with moderately thick walls (not compressed). Fibres to the outside of peripheral

vascular bundles wider than those between them Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a shallow arc. Widest tracheids in peripheral vascular bundles evenly distributed. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Phloem with wide sieve cells Bundle sheath parenchymatous. Outer fibre-caps present, 2-4 layers. Inner fibre-caps present, 1 or 2 layers; or absent.. Medullary vascular bundles dispersed throughout CGT.

***Cannomois virgata-scirpoides* intermediate W17**

General observations

Plants 1,5-1,9m tall, growing on stony slope. Culms branching.

Cuticle and epidermis. Cuticular surface striate. Epidermal cell depth 37.1 um, width 19.2 um, depth to width ratio 1.9. Outer cell wall moderately thick. Convex. Anticlinal walls straight. Stomatal apparatus superficial. Guard cell ridges at top and bottom. Subsidiary cells' inner portion bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 36.5 um, width 9.8 um, length to width ratio 3.7. Inner peg cell length 39.1 um, width 9.5 um, length to width ratio 4.1. Inner chlorenchyma layer not interrupted by sclerenchyma ridges. Lining cells of substomatal chamber

extend up to halfway into inner chlorenchyma layer. In contact near inner and outer ends only and along sides, leaving apertures in the inner half of the substomatal tube. Cell ends pointed.

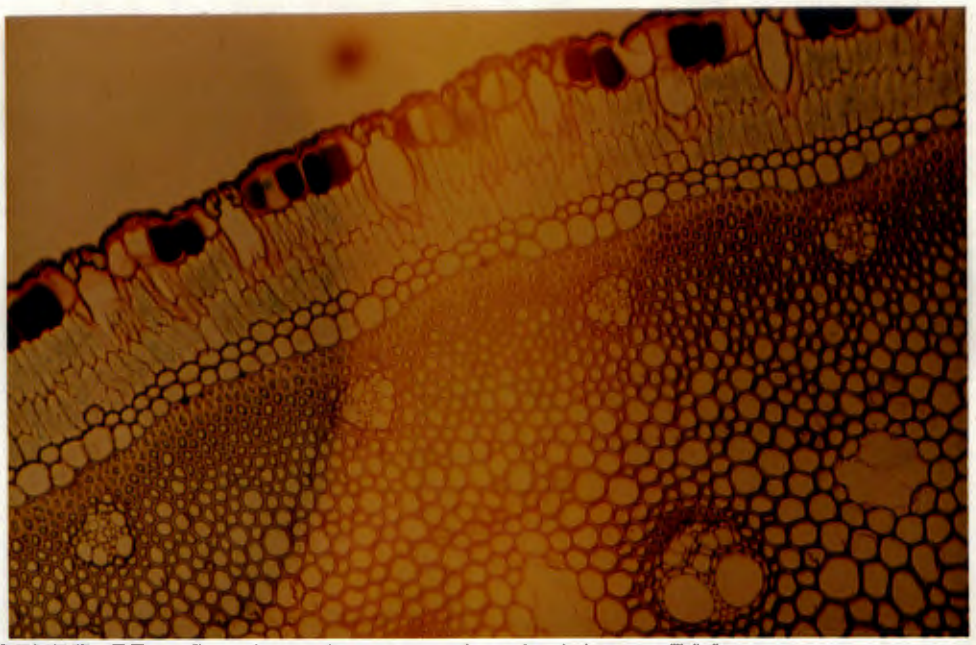

FIGURE 29. *C.virgata x scirpioides* x200

Parenchyma sheath. More than 1 layer of cells in places. Sheath outside sclerenchyma ridges entire. Silica bodies or granules in outer layer of sclerenchyma sheath.

Central ground tissue. Sclerenchyma Sheath 4-15 layers. Ridges slight. Fibres homogenous throughout sheath (or almost so), differentiated between ridges and areas to the outside of the peripheral vascular bundles, and narrow and very thick-walled in outer portion of sheath, wider and with moderately thickened walls at inner portion. Fibres between peripheral vascular bundles narrow with very thick walls. Fibres to the outside of peripheral vascular bundles of

similar dimensions as ridge fibres; or wider than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a deep horseshoe. Widest tracheids in peripheral vascular bundles in center of arrangement. Medullary vascular bundles with xylem and phloem

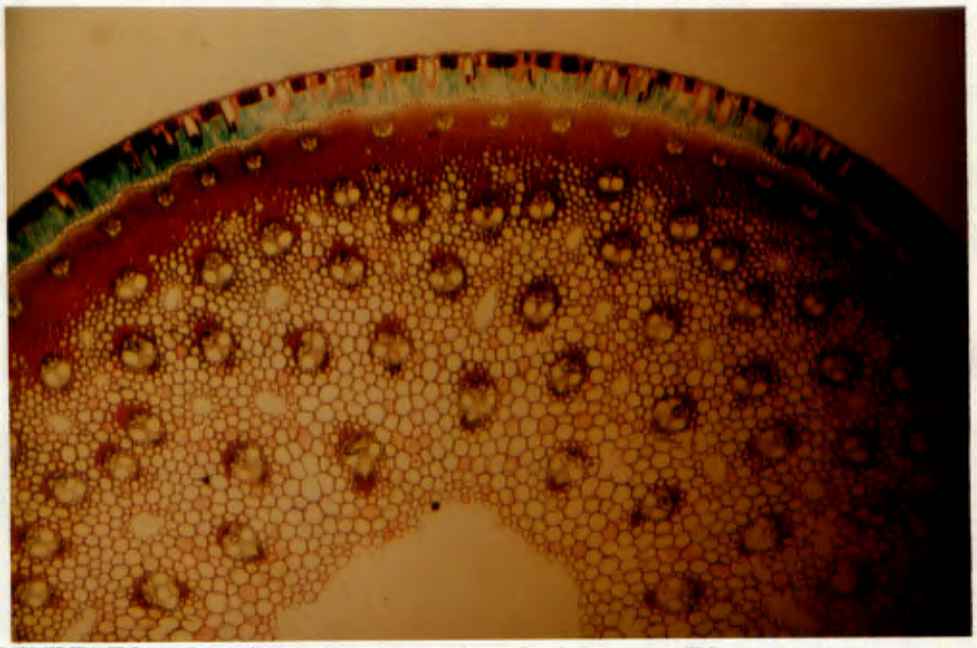

FIGURE 30. *C.virgata x scirpioides* x 50

separated by parenchyma cells. Bundle sheath sclerenchymatous. Outer fibre-caps present, 4-7 layers. Inner fibre-caps present, 2-5 layers. Medullary vascular bundles dispersed throughout CGT.

Cannomois scirpioides **(Kunth.) Mast. W15**

General observations

Plants 50-60cm high, occupying a well-drained, stony ridge.

Cuticle and epidermis. Cuticle thick; surface smooth to slightly papillose . Epidermal cell depth 92.8 um, width 19.4 um, depth to width ratio 5.1. Outer cell wall very thick, flat. Anticlinal walls wavy and separated to depth of outer cell wall. Stomatal apparatus sunken, overarched by neighboring epidermal cells. Guard cell ridges at top and bottom. Subsidiary cells' inner portion bulbous.

Chlorenchyma layer. Chlorenchyma peg cell length (outer layer) 84.5 um, width 7 um, length to width ratio 12.1. Inner peg cell length 90.1 um, width 6.8 um, length to width

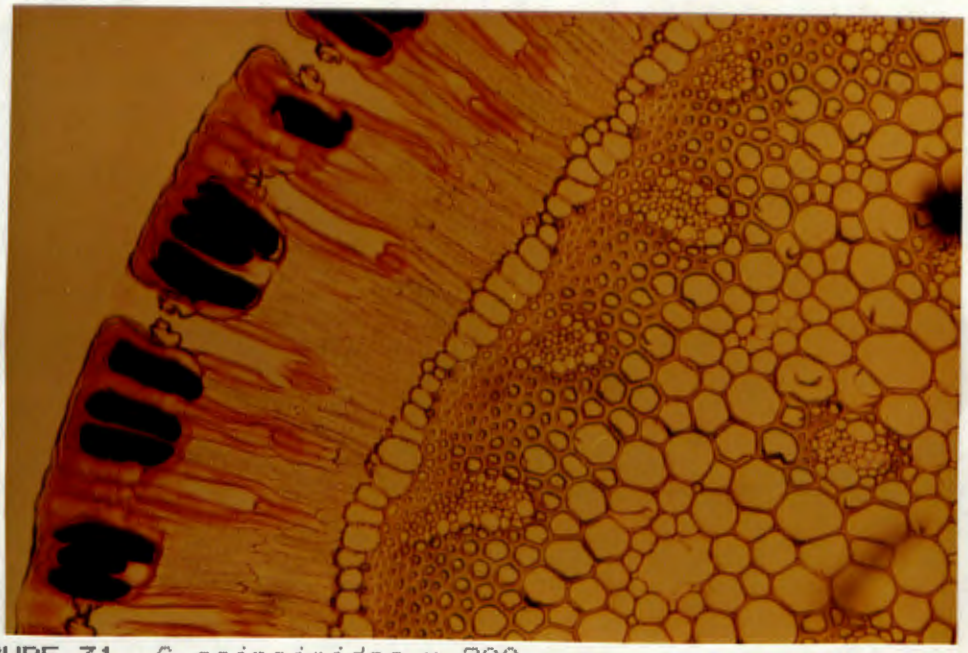

FIGURE 31. *C.scirpioides* x 200

ratio 13.3 . Inner chlorenchyma layer not interrupted by sclerenchyma ridges. Lining cells of substomatal chamber extend into epidermal layer, up to halfway into inner chlorenchyma layer, or sometimes over halfway. In contact along sides, leaving apertures in the inner half of the substomatal tube. Cell ends blunt or pointed.

Parenchyma sheath. More than 1 layer of cells in places (especially at ridges). Sheath outside sclerenchyma ridges reduced in cell size; or entire. Silica bodies or granules in outer layer of sclerenchyma sheath.

Central ground tissue. Sclerenchyma sheath 7-10 layers. Ridges absent. Fibres differentiated between ridges and areas

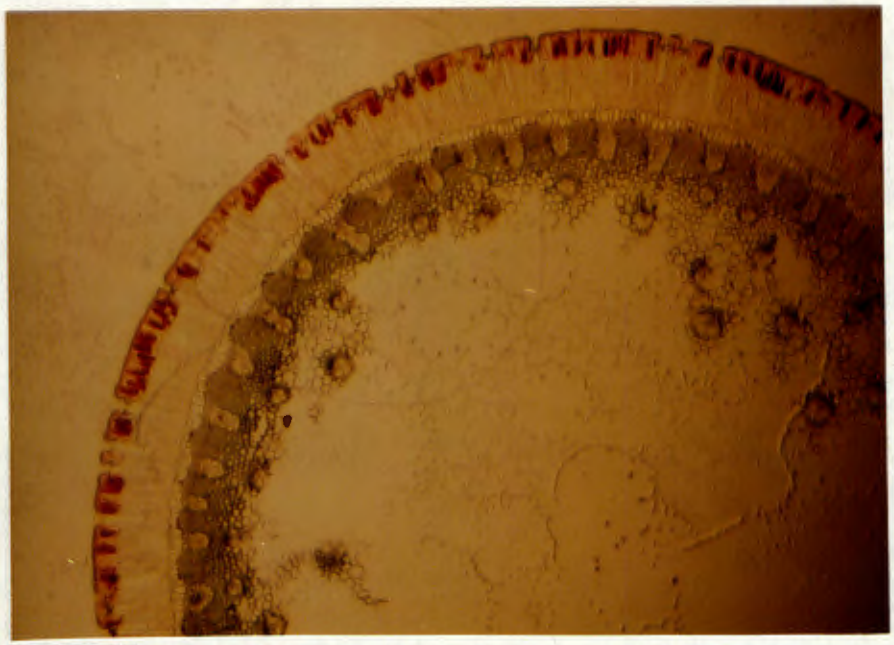

FIGURE 32. *C.scirpioides* x 50

to the outside of the peripheral vascular bundles. Fibres between peripheral vascular bundles with moderately thick walls. Fibres to the outside of peripheral vascular bundles

wider than ridge fibres. Central ground tissue with central cavity and small cavities dispersed between vascular bundles. Xylem tracheids in peripheral vascular bundles arranged in a deep horseshoe to v-shaped (elongated). Widest tracheids in peripheral vascular bundles in center of arrangement. Medullary vascular bundles with xylem and phloem separated by parenchyma cells. Bundle sheath sclerenchymatous. Outer fibre-caps present. 2-4 layers. Inner fibre-caps present. 1 or 2 layers. Medullary vascular bundles dispersed throughout CGT.

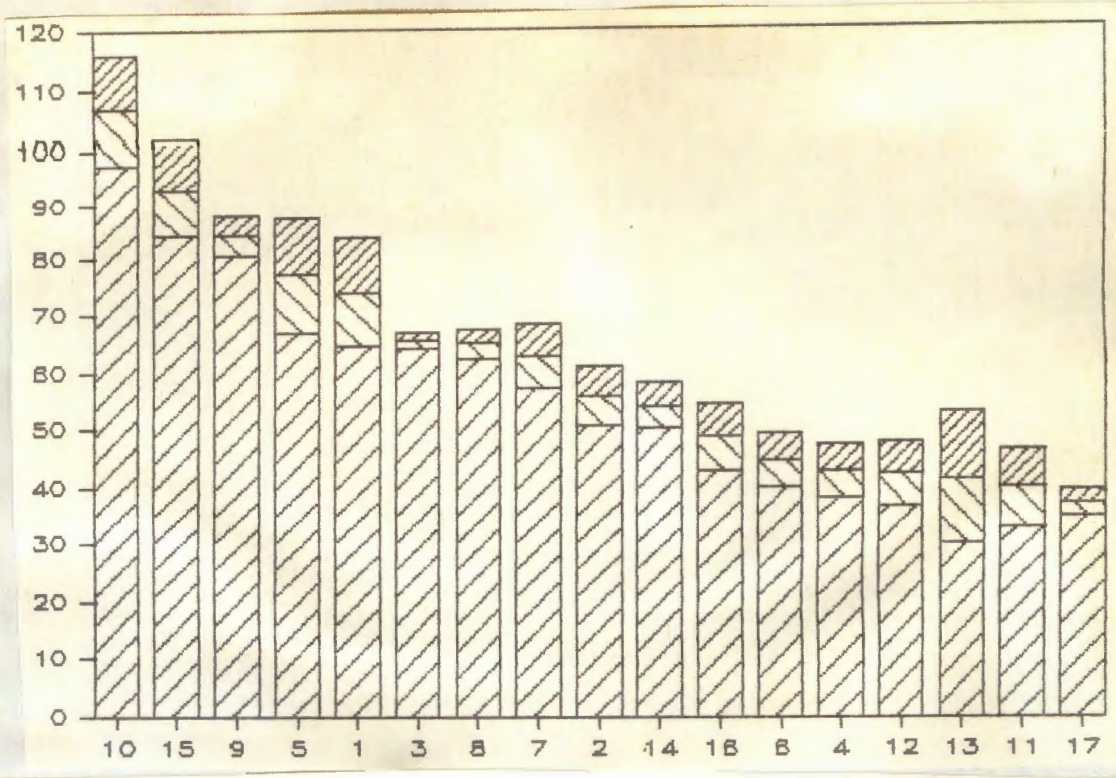

FIGURE 33 Epidermal cell depth; horisontal lines depict means and standard deviations for each population.

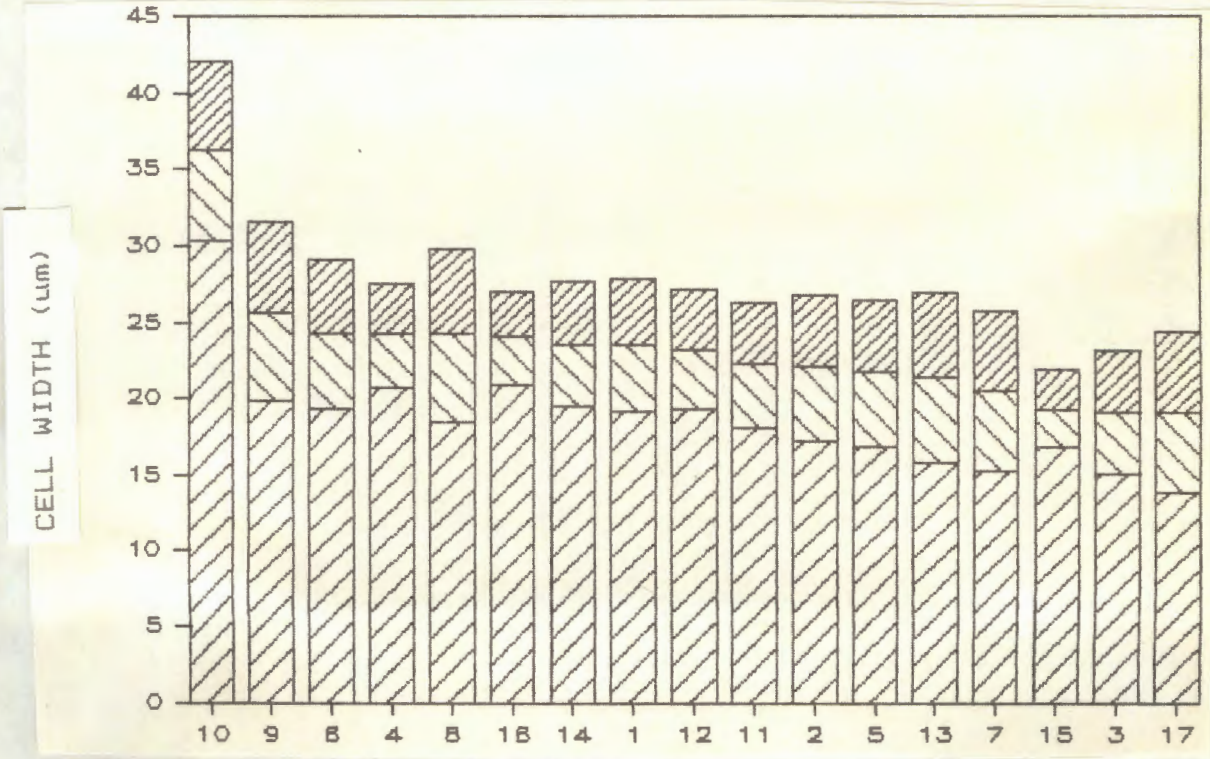

FIGURE 34 Epidermal cell width; legend as for fig. 33.

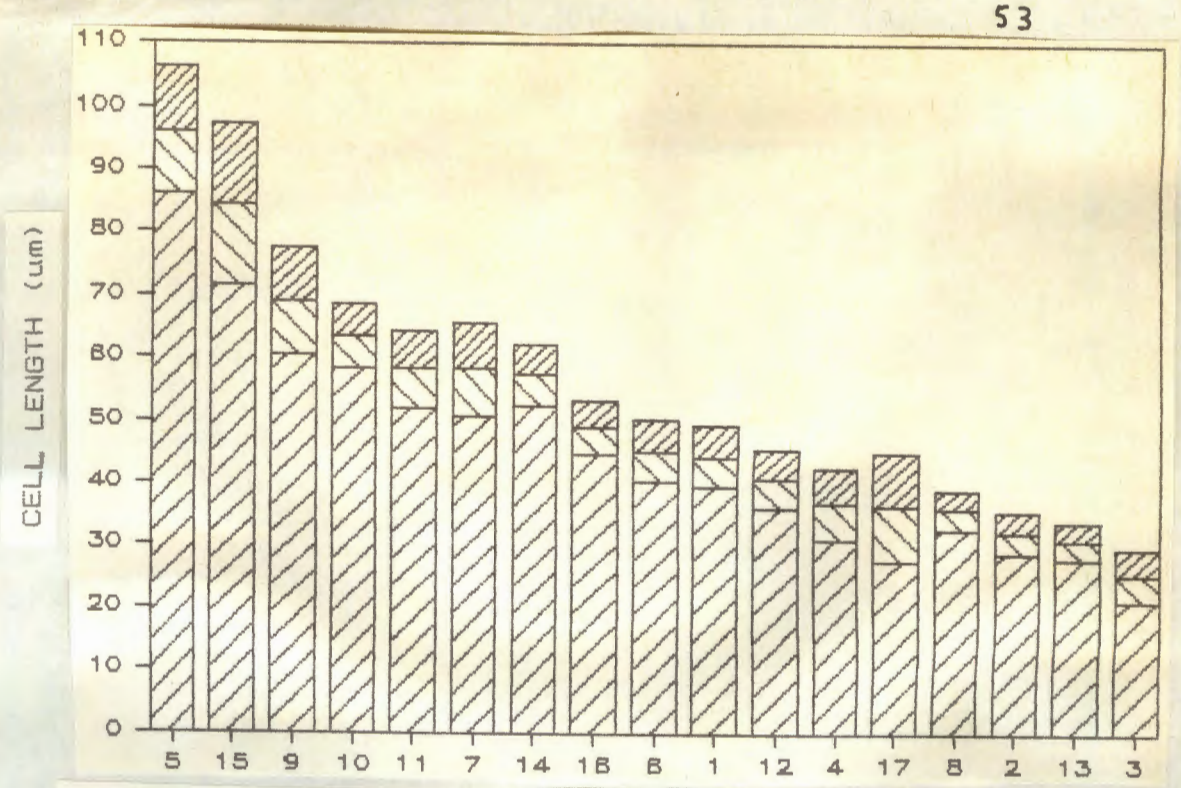

FIGURE 35 Outer peg cell length; legend as for fig. 33.

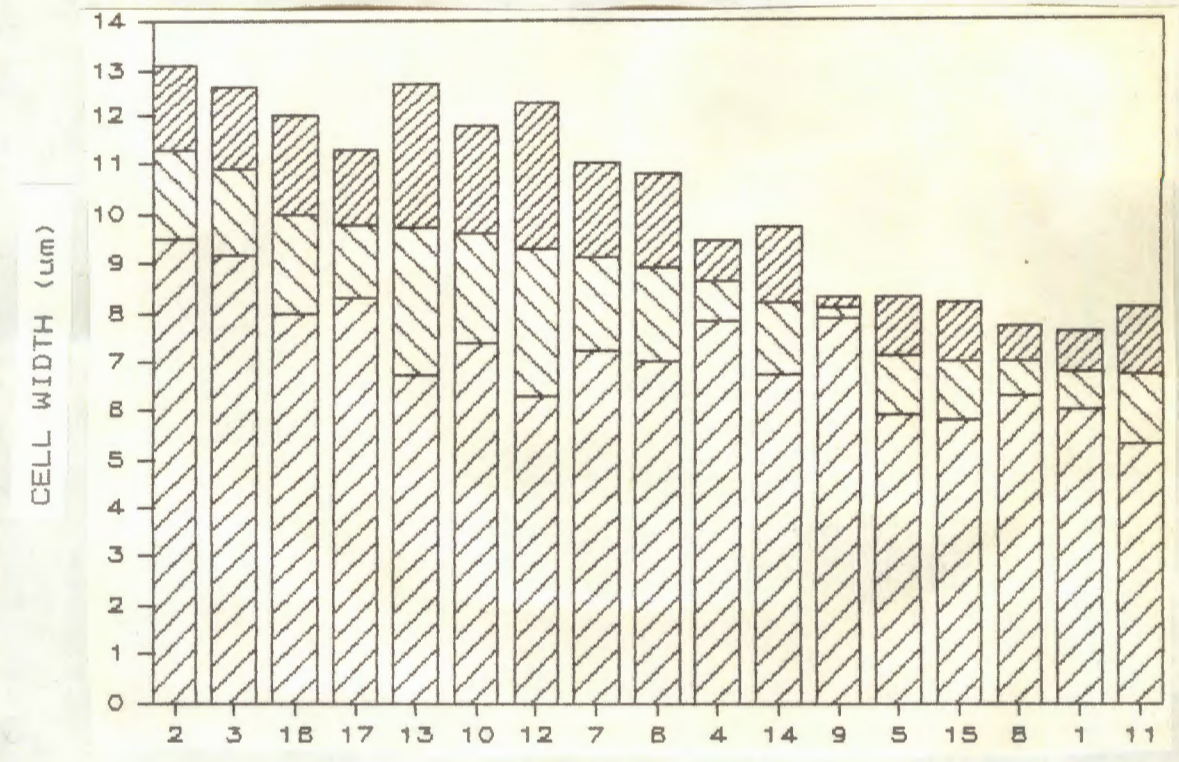

FIGURE 36 Outer peg cell width; legend as for fig. 33.

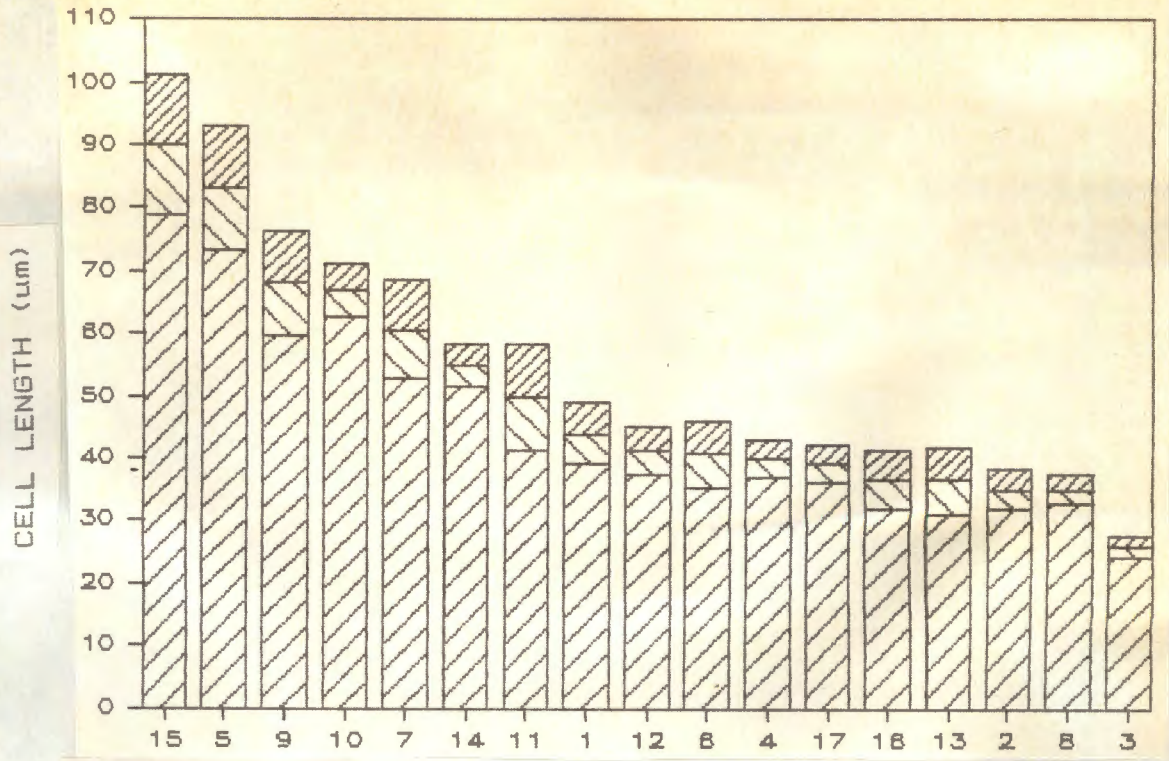

FIGURE 37 Inner peg cell length; legend as for fig. 33.

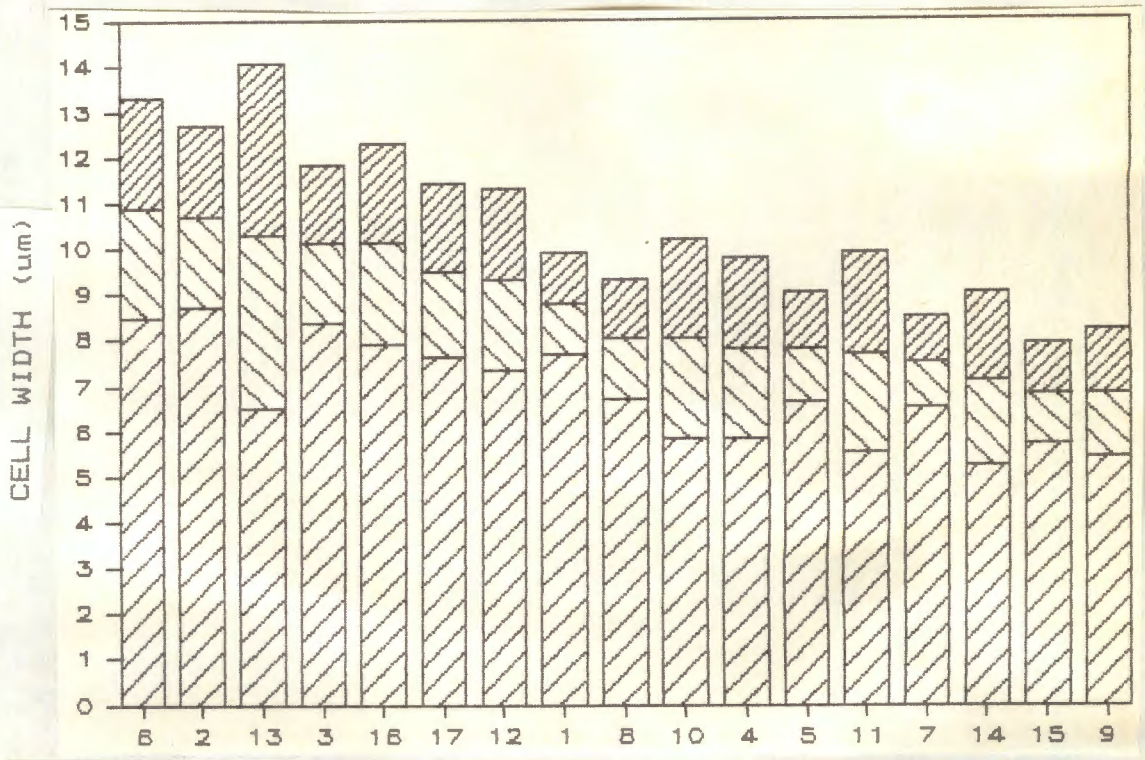

FIGURE 38 Inner peg cell width; legend as for fig. 33.

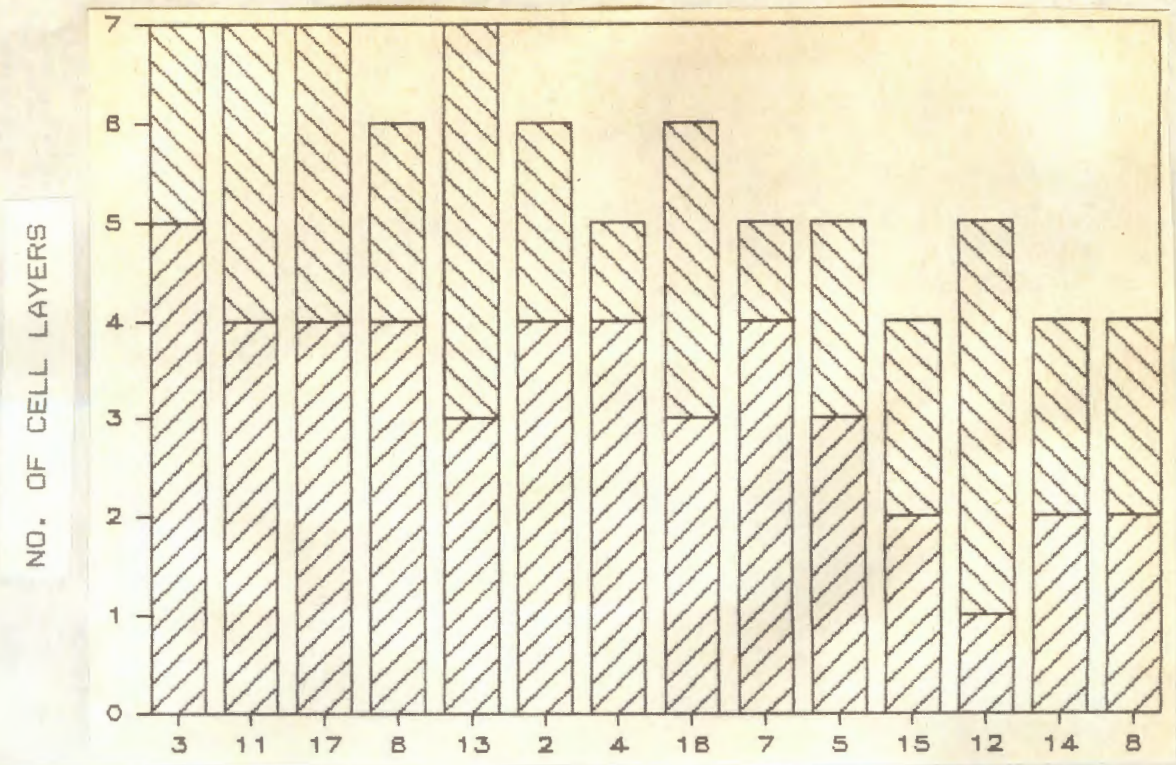

FIGURE 39 Outer fibre-cap seriation of vascular bundles; Horizontal lines indicate minima and maxima.

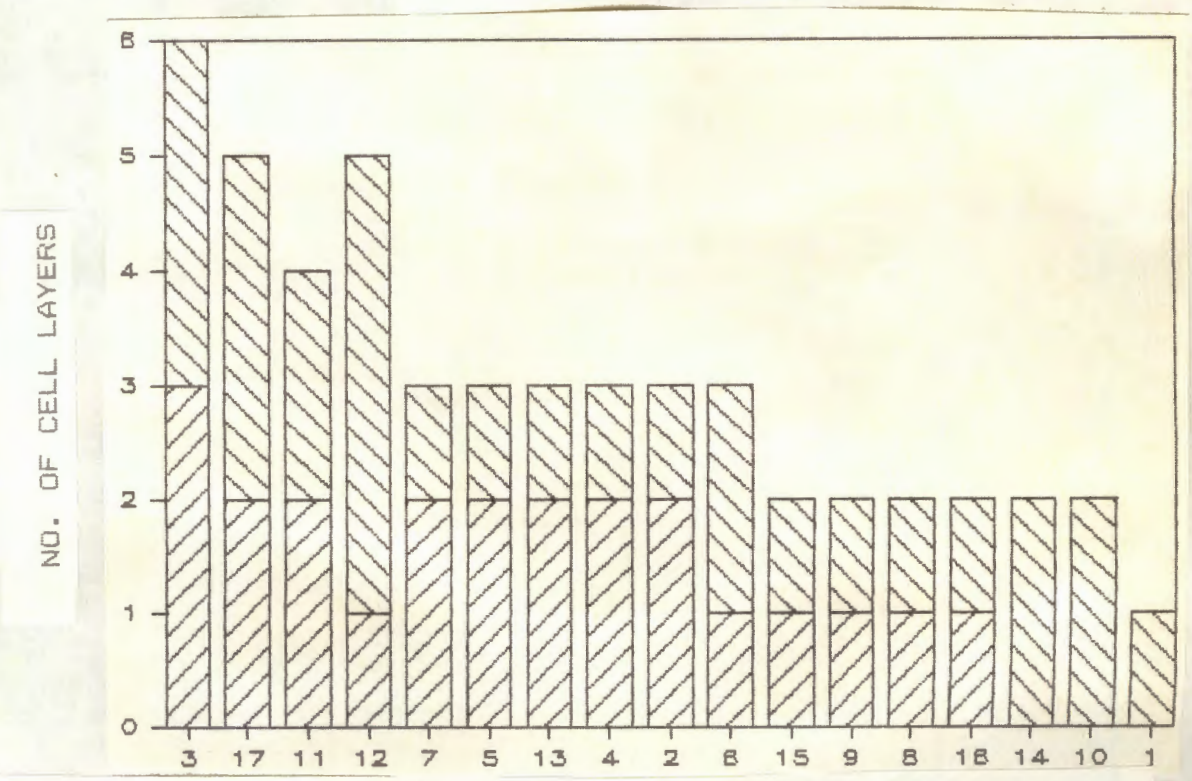

FIGURE 40 Inner fibre-cap seriation of vascular bundles; Legend as for fig.39.

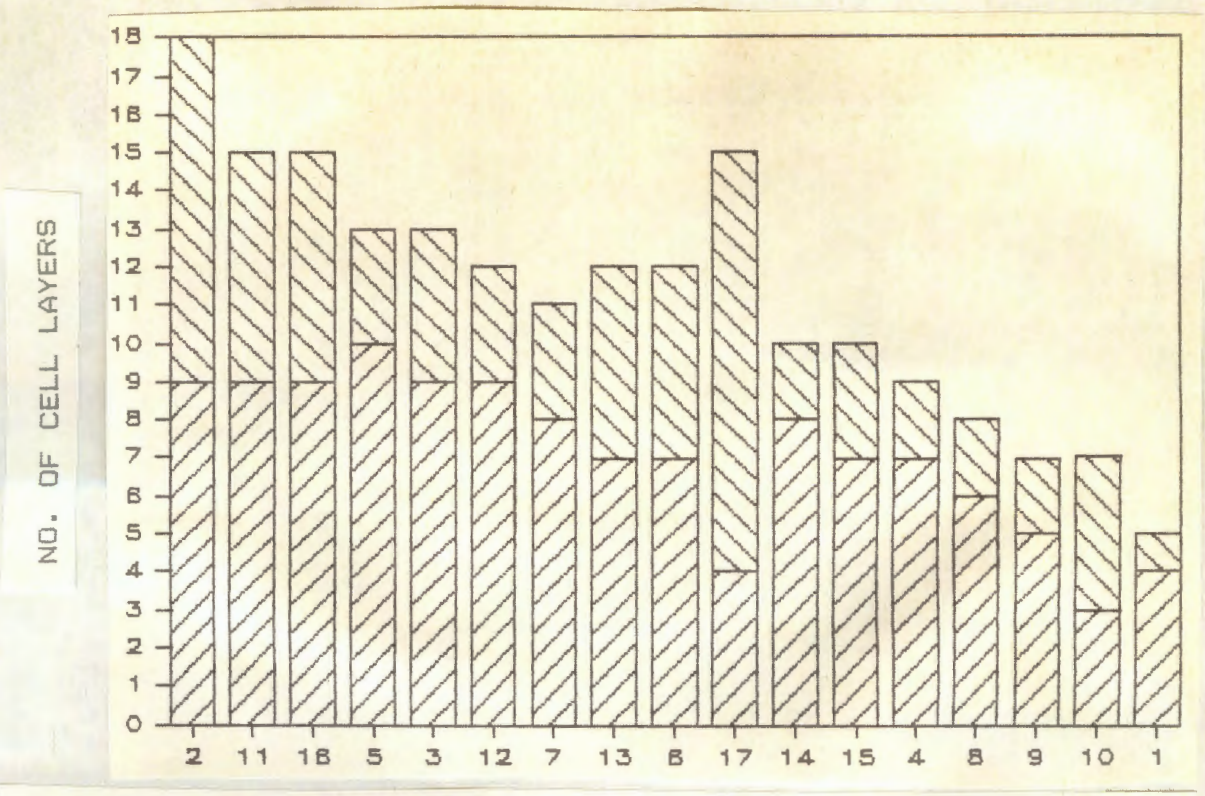

FIGURE 41 Seriation of sclerenchyma sheath; Legend as for fig.39.

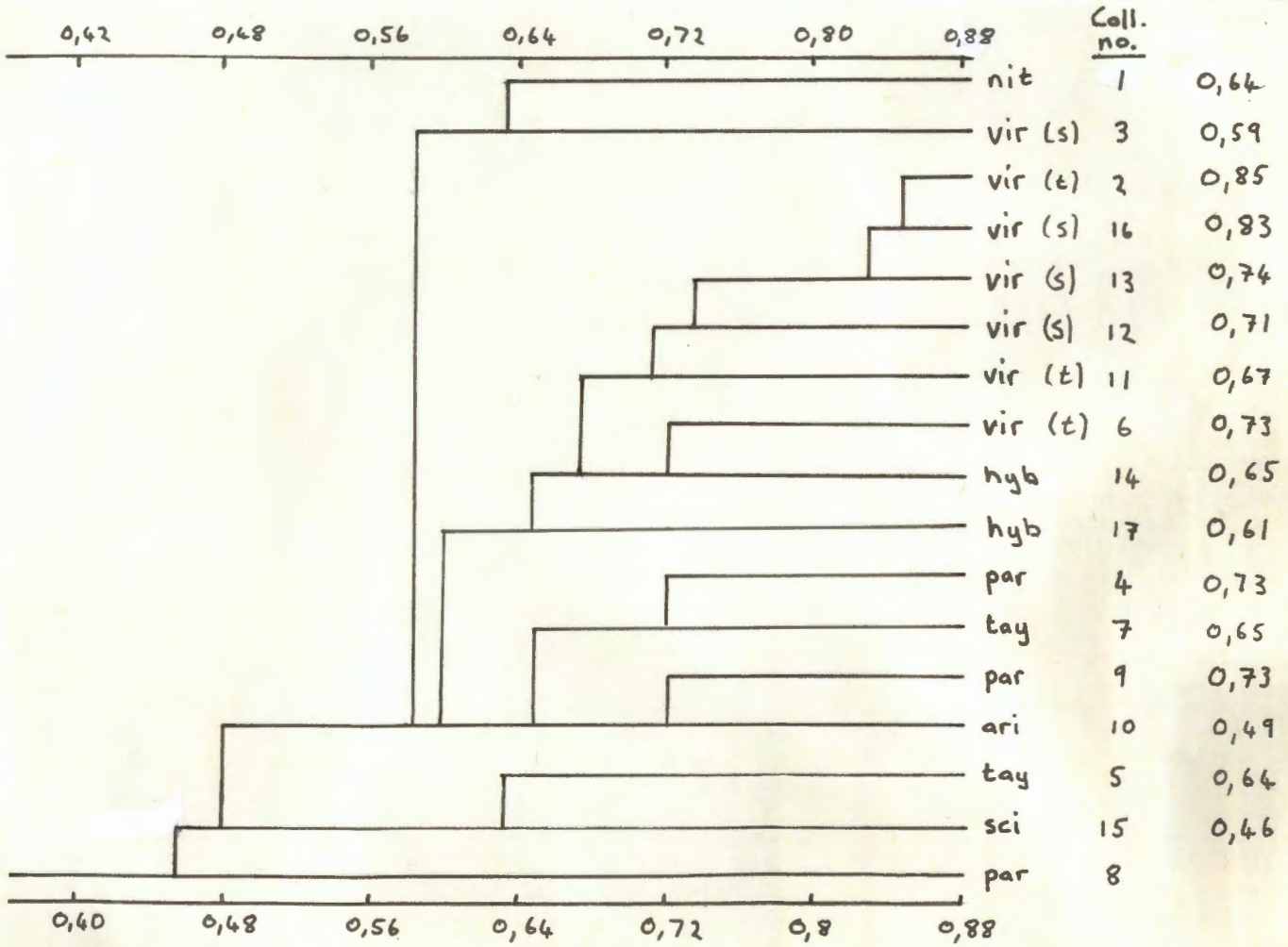

FIGURE 42 Dendrogram derived from the NT-SYS cluster analysis of the *Cannomois* populations. (UPGMA)

PHYTOCHEMISTRY:

Materials and methods

Fresh culm material was collected from the populations listed in appendix A.

The culms were stripped of their floral parts, before being cut up and dried at 40°C for three days. They were then ground and sieved to obtain a particle size of less than 600 um. For the extraction, the technique of Bate-Smith (1974), was followed, with some modifications. One gram of dry material was extracted by boiling in 90% MeOH (3x10 ml) and again using 50% MeOH (3x10 ml). Extracts were decanted through glass wool and combined. The volume was reduced to 20 ml. under rotovap. Six ml. HCl (conc.) was added to each sample and they were hydrolyzed for 40 min. on a waterbath (100°C). The extracts were cooled and diluted with distilled water, filtered (through glass wool) into a separating funnel, and extracted with ether (3x15 ml). Ether extracts, containing flavonoids and simple phenols, were pooled, washed with water, dried (using anhydrous NaH_2SO_4), and evaporated to dryness over a waterbath. The residue was taken up in 100% EtOH, to a volume of 5 ml.

The remaining aqueous phase was extracted with amyl-alcohol (3ml). Extracts, which contained the anthocyanidins, were evaporated to dryness and the residue was taken up in 1% methanolic HCl (5 ml; HCl:MeOH = 1:99).

The ether extract components were separated further by descending paper chromatography using the solvent systems BAW (n-butanol: acetic acid: water, 4:1:5), FORESTAL (conc.HCl: acetic acid: water, 3:30:10) and 60% acetic acid. The amyl-alcohol extracts were separated using BAW and FORESTAL. The chromatograms were studied by noting the colour of spots in visible light, under UV-radiation, and under UV-radiation when exposed to NH_3 fumes. The mobility coefficient (R_f) was determined for each spot. Standard flavonoid markers were co-chromatographed and included the flavonols, simple phenols and anthocyanidins shown in Table 1.

TABLE 1: Flavonoid markers which were co-chromatographed to permit identification of spots.

Flavonols	Simple Phenols	Anthocyanidins
Myricetin	Chlorogenic acid	Pelargonidin
Quercetin	P-coumaric acid	Delphinidin
Kaempferol	Caffeic acid	
	Synapic acid	
	Phenolic acid	

The chromatogams were screened for the presence or absence of these compounds only, although many unidentified compounds were evident which could yield valuable information upon further analysis.

Results

The results of the phytochemical analysis are represented in Table 2. The taxa are listed according to the earlier taxonomic hypotheses (published classifications). Quercetin occurred throughout the taxa, but was low in W15, W10 and W5. Myricetin was possibly only present in three *C.virgata* specimens (both short and tall forms) and in one of the hybrid specimens, although positive identification was not possible, as the spots could have simply been extensions of the trailing spots of quercetin. Kaempferol was absent in all species.

Chlorogenic acid appeared only in one specimen of *C.parviflora*. Caffeic acid and phenolic acid were common throughout, but their presence was uncertain in one of the hybrids. Synapic acid was present in *C.parviflora* and *C.aristata*, and occasionally in *C.virgata* (both forms).

The anthocyanidins Pelargonidin and Delphinidin had an almost universal distribution. Pelargonidin was absent from *C.taylorii*, *C.scirpioides*, and from one of the short *C.virgata* samples. Delphinidin was only absent in *C.aristata*. Various other spots showed up on the chromatograms, indicating other flavonoid compounds which may be useful as taxonomic markers in later investigations.

TABLE 2: The distribution of some common flavonoids in *Cannomois*.

Population		Pigment									
		Flavonols				Simple Phenols				Antho-cyanidins	
		Quer	Myr	Kaem	Chlo	Caff	Phen	P-cou	Syn	Pel	Delph
C.nitida	W1	+	–	–	–	+	+	+	–	+	+
C.virgata (short form)	W3	+	–	–	–	+	+	+	+	+	+
	W12	+	?	–	–	+	+	+	–	low	+
	W13	+	–	–	–	+	+	–	–	–	+
C.virgata (Tall form)	W2	+	–	–	–	+	+	–	+	+	+
	W6	+	?	–	–	+	+	–	–	+	+
	W11	+	?	–	–	+	+	+	+	low	+
	W16	+	–	–	–	+	+	–	–	+	+
C.virgata x scirpioides	W14	+	?	–	–	+	?	–	–	+	+
	W17	+	–	–	–	+	+	–	–	+	+
C.scirpioides	W15	low	–	–	–	+	+	–	–	–	+
C.parviflora	W4	+	–	–	–	+	+	–	+	+	+
	W8	+	–	–	+	+	+	–	+	+	+
	W9	+	–	–	–	+	+	+	+	+	+
C.aristata	W10	low	–	–	–	+	+	+	+	+	–
C.taylorii	W5	low	–	–	–	+	+	–	–	–	+

+ : Presence
– : Absence
? : Possible presence obscured by other spots
Quer=quercetin; Myr=myricetin; Kaem=kaempferol;
Chlo=chlorogenic acid; Caff=caffeic acid; Phen=phenolic acid;
P-cou=p-coumaric acid; Syn=synapic acid; Pel=pelargonidin;
Delph=delphinidin.

DISCUSSION

Cutler (1969) noted that the genus *Cannomois* showed a limited range of anatomical characters. Most of the characters investigated in the present study showed little or no variation among the taxa, or a wide range of variation within a taxon. This is exemplified by the lining cells of the substomatal chamber, which exhibited several states even in one specimen. The thickness of the sclerenchyma sheath showed a similar variation pattern at the population level for some species, e.g. in the suspected hybrid, *C.virgata x scirpioides*, although in others it seemed to be quite consistent.

One of the few consistent characters was found to be the organization of the stomatal apparatus. Stomatal guard cells were either deeply sunken, or superficial to only slightly sunken, agreeing with Cutler's (1969) division of the genus into two groups on the basis of this character. His use of the parenchyma sheath being either entire or irregular due to the slight intrusion of the sclerenchyma ridges, and his correlation of this character to the division based on stomatal guard cell position, is not supported by the results of this investigation. *C.virgata* showed both types of sheath for different populations.

The value of this character is lowered further by the lack of correlation to the proposed division of *C.virgata* (Linder 1985) into a "short" and a "tall" form, as both these

forms showed between-population variation for entirety of the parenchyma sheath.

No anatomical pattern could be discerned among the *C.virgata* populations investigated, to justify recognition of the separate forms, although field observations would certainly suggest a distinction. It may be useful, however to study the anatomy of the rhizomes from various populations, as their organization seems to account for the different habits characteristic of the two forms, and perhaps also for the ability to frequent different habitats. Flavonoid characters likewise could not distinguish different forms.

APPENDIX A: Field collection data.

DATE	Coll. no.	Species	Locality
20/2/88	W1	C.nitida	Brandwag peak, Fonteintjiesberg, Worcester
20/2/88	W2	C.virgata	Fonteintjiesberg, Worcester
20/2/88	W3	C.virgata	Fonteintjiesberg, Worcester
5/3/88	W4	C.parviflora	Pakhuis pass, Clanwilliam
5/3/88	W5	C.taylorii	Pakhuis pass, Clanwilliam
5/3/88	W6	C.virgata	Eikeboom, S of Uitkyk pass, Cederberg
5/3/88	W7	C.taylorii	Dwarsrivier, Cederberg
6/3/88	W8	C.parviflora	Wolfberg Cracks
6/3/88	W9	C.parviflora	Wolfberg Cracks
6/3/88	W10	C.aristata	Wolfberg, on plain between Cracks & Arch
16/7/88	W11	C.virgata	Montagu pass, Outeniqua range
16/7/88	W12	C.virgata	Montagu pass, Outeniqua range
16/7/88	W13	C.virgata	Southern slope of Swartberg pass
16/7/88	W14	C.virgata x scirpioides	Ou Tol, Swartberg pass
16/7/88	W15	C.scirpioides	Ou Tol, Swartberg pass
16/7/88	W16	C.virgata	Gamka rd.,off Swartberg pass
16/7/88	W17	C.virgata x scirpioides	Swartberg pass

APPENDIX B: R_f-values for standard markers, expressed as percentages, under the conditions of this analysis. (R_f x 100)

	BAW	FORESTAL	60% AcOH
Myricetin	62,93	4,86	25,97
Quercetin	82,66	5,5-6,8	32,95
Kaempferol	85,17	6,4-8,9	44,12
Chlorogenic acid	70,93		76,46
Caffeic acid	83,7-85,9		62,65
Synapic acid	85,26		80,05
P-coumaric acid	90,67		72,77
Phenolic acid	90,87		76,75
Pelargonidin		22,69	
Delphinidin		13,36	
Brinjals extract (Delphinidin ?)		9,26	