Section A-Research paper

THE STRUCTURE OF THE STEM AND ROOTS OF SOME SPECIES OF THE GENUS ACANTHOPHYLLUM C.A. MEU COMMON IN DIFFERENT CONDITIONS.

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Abstract. The morphological and anatomical structure of the stem and roots of some plant species of the genus Asanthophyllum C.A. Mey, living in different habitats, was studied and analyzed.

In plant stems, xylem consists of one inner ring and 20 narrow arcuate bundles. The annual bundles of xylem are more or less markedly outlined, the lumens of the vessels are located along the radius. Phloem developed, ring structure. The epidermis, parenchyma of the cortex, and the cork were exfoliated. Outside of the

phloem, there are 3-4 annual rings of small-cell thick-walled perivascular fibers, completely different from those of the first year. The core is narrow, slit-like.

The anatomical structure of perennial roots of plants of 17 species of p.Acanihophyllum, 2 species of p. Kughitangia and 3 species p. Gypsophila. The vast majority of the studied species of the first two genera have a concentric, polycambial root structure. A distinctive feature of the roots of the considered species (with the exception of the species of the sec. Turbinaria and A. sordidum from the sec. Pleiosperma) is the absence of mechanical lignified tissues in the xylem. Only the walls of the vessels become lignified, all other tissues are living with non-lignified cellulose membranes.

Key words: genus, family, species, type, range, morphology, anatomy, stem, root, xylem, phloem.

Introduction. Literature information on the anatomical structure of the stem of the genera under study is scarce and fragmentary. The structure of the annual shoot of some species was studied by such scientists as O.N.Radkevich, B.N.Niyazov, B.Bykova, D.Yu.Tursunov, M. Musaeva and K.Z.Zakirov [1].

The annual stems of most species are omitted by simple and glandular stalked-capitate or both types of trichomes of varying length and density. The outline of the cross section is slightly oblong-oval. The epidermis of the stem in all studied species is single-layered, its cells are slightly tangentially oblong, oval or round-oval. Under the epidermis there are 1-3 (4) layers of cortical parenchyma cells, which, as a rule, contain small chlorophyll grains, which speaks in favor of the participation of this tissue in photosynthesis.

Under the parenchyma of the cortex of the genus Acanthophyllum, regarding the origin of which there is no consensus among researchers, there are multilayer perivascular fibers.

As is known, the term sclerenchyma refers to complexes of thick-walled, often lignified cells, the main function of which is mechanical. Most often, sclerenchymal cells are divided into fibers and sclereda. At the same time, the

fibers are described as long cells with poorly visible pores of various configurations - slit-like, cruciform, triangular, and others, and sclereids - as relatively short.

The ontogeny and topographic position of xylem fibers are usually quite clear, that is, they develop from the same meristematic tissues as other xylem cells and form an integral part of this tissue. The relationship of the extraciliary fibers to the corresponding tissue systems seems to be less simple and clear. Some fibers of this type can be associated with the phloem with the same certainty as xylem fibers with xylem, and in many other fibers the ontogenetic relationships are less clear.

The fibers located in the outermost part of the conductive cylinder are often called pericycle fibers. A recycle is understood as a tissue that differs from the conducting tissue both in its topographic position and ontogenetically. However, in the stem of most dicotyledons, whose ontogeny has been sufficiently studied, the phloem adjoins the cortex, and no tissue separating them can be observed between them, which can be identified with the pericycle in the usual sense of the word [1].

Meanwhile, in works devoted to the anatomical structure of the stem of certain species of the taxa we are studying, some authors [2] call perivascular fibers located between the parenchyma of the cortex and phloem a multi-row pericycle, fibers with thickened lignified walls, others - pericyclic, bast fibers [4], fibrous elements, perivascular fibers. As can be seen from the literature data, there is no consensus among researchers of the clove family on the issue of the origin of this tissue [3].

Sometimes extracilliary fibers are combined into one group - bast fibers obtained from the outside of the cambium, that is, the extracambial region of dicotyledonous stems [1], which in most cases consists of phloem fibers. In our work, we use the term "perivascular fibers" located along the periphery of the conducting cylinder from the innermost layer of the cortex, and "bast (phloem) fibers" arising in the primary or secondary phloem.

Inside the parenchyma of the cortex there are 5-13 (17) layers of perivascular fibers of pro-cambial origin, 2-5 outer layers of which consist of smaller, but very

thick-walled cells. The inner layers are formed by larger cells, the thickness of the cell walls of which decreases in the direction from outside to inside.

As you know, phellogen is a meristem that forms a periderm, which consists of a phellem, usually called a cork, and deposited by phellogen towards the outside, and phelloderm, also deposited by phellogen towards the inside, and resembling root parenchyma.

1. A. pungens. The outer walls of the epidermal cells of the annual stem from the Karakum are slightly thickened, covered with a thin (0.2-0.3 micron) layer of striated cuticle, the stem is pubescent with simple small and stalked-capitate glandular hairs. The latter are not indicated in the systematic summaries in the diagnosis of the species. Hairs mostly 1-, rarely 2-3-celled. Under the epidermis there are 3-4 layers of thin-walled parenchyma of the cortex, bordering on 10-13 layers of perivascular fibers, 4-6 outer layers of which are small-celled and thick-walled. The cells of the inner layers increase in size towards the phloem, while the wall thickness, on the contrary, decreases. The phellogen is laid directly above the phloem in the form of a continuous single-layered ring.

With the appearance of the first phellem cells, the destruction of the walls of the perivascular fibers located directly above its cells begins. Further destruction goes towards the periphery. There is also destruction of individual or groups of cells outside, located under the parenchyma of the cortex. When the cells are destroyed, their walls turn into very thin zigzag fibril threads, intermittent in places.

It should be noted that in some specimens of plants of this species, the destruction of the cells of this tissue under the bark is stronger than in the plant described above.

The degree of development of the phellem and the destruction of the perivosular fibers depend on the habitat conditions. For example, in plants from the Karakum (from the vicinity of Repetek), these processes begin early - before flowering. In plants from the southern slopes of the Dzungarian Alatau, the first phellem cells are formed in July, and the destruction of the cells of perivascular

fibers is not observed, which is apparently due to the late start of vegetation in the local climatic conditions.

In the first year of vegetation, the internal cambium does not appear. It does not occur in perennial plants from the Bukhara region and Pamir-Alay. However, in the conditions of Tashkent, at the beginning of the growing season in the second year, it is formed in the perimedullary zone of the core, which forms the inner xylem and phloem [4]. The inner cambium works for 3 years, and each year of vegetation, one group of arcuate xylem is formed on the sides.

On a cross section of a four-year-old shoot in plants under natural conditions, the xylem consists of a continuous xylem ring of the first year of vegetation, the second year - of two lateral bundles (one on each side) of an arcuate shape, and from the 3rd and later years it has a bundle structure and consists of 8 long radial inversely cone-shaped bundles, which are separated by parenchymal rays of various widths and contain many drusen.

The young phloem and its old part (outer) at the perennial stem turns into collenchymatous fibers. Above the phellem (3-4 layers) there are separate strips of 2-4 layers of cells of arcuate perivascular fibers. Outside of them is a destroyed layer of this tissue in the form of a cork, followed again by strips (arc-shaped) of perivascular fibers. Then their alternation is repeated.

2. A. lilacin. The annual stem is pubescent with relatively sparse 1-2-celled simple and stalked-capitate glandular hairs, the outline of the transverse section is oblong-tetrahedral. The cortical parenchyma is 2-layer, with a green tint; mechanical tissue consists of 5-8 layers of perivascular fibers, 2-4 outer layers of which consist of small thick-walled cells. In the budding phase, the internal cambium is already laid, which gives rise to internal phloem and arcuate xylem. The core is preserved in the form of a gap. Fellogen is laid in the first year of vegetation and forms 1-2 layers of fellema, however, unlike A.pungens, no destruction of sclerenchyma cells is observed. In a 2-year-old stem, the epidermis, together with the bark, is exfoliated. The phloem ring is very wide; 1-2 rows of large cells with drusen are formed in its middle. Outside of the phellem, a 2-3-layer

mechanical tissue is preserved, behind it is again a 2-3-layer phellem of destroyed cells of perivascular fibers, etc. Unlike A.pungens, mechanical tissue has a continuous ring. In the 2nd year of vegetation, internal xylem and phloem are laid. Xylem in the second year retains a continuous arcuate shape. No changes were observed in the structure of the xylem in the first and second years. Unfortunately, due to the lack of material, the perennial (3-4 year old) stem was not studied by us.

Thus, this species sharply differs from A. pungens in the structure of perivascular fibers and xylem.

3. A. subglabrum. Annual stem glabrous or nearly glabrous. The outline of the transverse section is rounded, the parenchyma of the cortex is 2-3-layered, the perivascular fibers are 4-6-layered, 2-3 of its outer layers are small-celled and thick-walled. The phellogen is present, but the fellem is not yet formed, and destruction of the sclerenchyma cell walls located above the phellogen is not observed.

In a perennial (6-year-old) stem, the xylem in the first year, like in other species, is annular. Starting from the second, the structure of the xylem of each year consists of 2 arcuate bundles, separated by wide parenchymal stripes at the poles (at the ends)

From the 5th year of vegetation, the xylem of each year is already formed by 4 tangential rows, separated by radial parenchyma strips.

Thus, in a 6-year-old stem, the xylem consists of one inner ring and 20 narrow arcuate bundles. The annual bundles of xylem are more or less markedly outlined, the lumens of the vessels are located along the radius. Phloem developed, ring structure. The epidermis, parenchyma of the cortex, and the cork were exfoliated. Outside of the phloem, there are 3-4 annual rings of small-cell thick-walled perivascular fibers, completely different from those of the first year. The core is narrow, slit-like.

The bundles, as they move away from the center to the periphery, naturally expand and, longitudinally separating, increase their number.

In the genus Acanthophyllum, an atypical phellogen is laid in the annual stem, and the cork (in the typical phloem) is formed from perivascular fibers, which is also repeated in the perennial stem.

Conductive system in species of one- and perennial stem species sec. Turbinaria and A.sordidum from sec. Pleiosperma has a continuous annular structure with clear boundaries of annual increments, which is typical for trees. In other species, the annular structure is broken and passes to a beam structure from 2-5 years of vegetation, depending on the species and group of species.

In the stem of p.Gypsophila species, phellogen (atypical) is formed only in 2 species - G. diffusa and G.kraschenninikovii - only at the 2nd year of life; in other species, phellogen is absent, which sharply differs from p. Acanthophyllum, but the transformation of perivascular fibers into a plug is similar to other genera studied.

According to the structure of the xylem of the perennial stem, we subdivide the species of the genus into 7 conditional types:

1st type - "A. mucronatum. Species sec. Turbnaria and A. Sordidum from sec. Pleiosperma is characterized by a continuous ring structure of the conducting system, the presence of annual growths of xylem, a strong development of the libriform, a low specific gravity (30-45%) of the lumen of the vessels, the destruction of perivascular fibers in various directions after the formation of the phellogen, the formation of a multilayer fellem near the perennial stem and the initiation of 2-3 -layered phelloderm. Such a stem structure is primitive not only for the genus Acanthophyllum, but also among all the studied taxa. The structure of the xylem of these three species can be called the normal structure of the stem, characteristic of most woody plants.

2nd type - "A. cyrtostegium". It is characterized by a ring structure of annual growths of xylem until the 4th-5th year of vegetation, then the structure of the xylem is multi-fascicular (14-18), the fascicles are separated by narrow obverse wedge-shaped bands of the ray parenchyma. The structure of the xylem of this

type, in terms of the degree of evolutionary advancement, occupies an intermediate position between "A. mucronatum" and "A. stenostegium.

3rd type - "A. stenostegium. The annual growth of xylem up to 5-6 years of age consists of 2 long arcuate bundles, separated at both ends by wide strips of the core parenchyma, then - from 8-12 bundles. This type is characteristic of the stems of A. korshinskyi, A. brevibracteatum, Aelatius, A. lilacinum, A.acelatum, A. kraschenninnikovii, A.adenophorum, A.stenostegium from cek.Oligosperma, A. schugnanicum, A. coloratum - from sec. Pleiosperma and A. serawschanicum, A. jarmolenkii - from cek. Macrostegia. Species of this type differ from each other in individual details of stem morphology and anatomy.

4th type - "A. borsezowii". Each annual growth consists of 4-6 arcuate bundles located directly next to the ring. The lateral bundles are located next to each other until the age of 5, then they are separated by wide radial stripes of the parenchyma. The bundles at the poles are also separated from the lateral bundles by wide bands of parenchyma with large, numerous drusen. The species of this group may differ in the presence or absence or number of xylem bundles at the poles and other details of the structure. A. pulchrum, A. borsczowii, A. leiostegium from cek. Oligosperma, A.glandulosum - from sec. Pleiosperma and A. korolkowii are from Macrostegia.

5 type - "A. tenuifolium. The structure is characterized by two-bundle xylem of 1-2 years and multibundle (8-12) of the third and subsequent years of vegetation. The bundles of the perennial stem are collateral, separated from each other by a ray parenchyma of various widths. This structure is typical for A. tenuifolium, A. albidum from sec. Oligosperma and speaks in favor of a greater advancement of the characters of their xylem than in the previous species.

6th type - "A. pungens". The xylem of the 1st year retains an annular structure, the 2nd year is formed by two separate arcuate bundles, then it consists of many (16-18) radial inversely wedge-shaped collateral bundles, where annual increments are not always clearly expressed. The bundles are separated by parenchymal rays of various widths, which, like the bundles themselves, expand to

the periphery. An example is one species, A.pungens. A similar structure is found only in the species of the same name and indicates that it is less advanced than A. tenuifolium and A. albidum.

7th type - "A. subglabrum" is characterized by a constant 4-beam arched annual growth that persists from the first to the last year of vegetation. This type of structure is typical for the stem of A.subglabrum.

An analysis of the obtained data on the study of the anatomical structure of annual and perennial stems of the genus Gypsophila allows us to conclude that the difference in the structure of the conducting system, especially xylem, between perennial grasses and semishrubs is almost imperceptible.

Among perennial grasses, G.krascheninnikovii has the most primitive stem structure - a continuous ring of xylem up to 2 years of age, however, the laying of a cork between annual growths of xylem is a secondary and advanced sign, which differs sharply from other species and genera. Species G. paniculata and G. bicolor have a multifascicular collateral xylem separated by narrow bands of ray parenchyma. Other species of this life form have the same fascicular structure, but are separated by wider bands of ray parenchyma. Among other species of both life forms, G. diffusa and G. herniarioides have the most primitive xylem structure with a continuous ring of annual xylem growth.

The most advanced type of xylem structure among the studied species of this genus is G. capituliflora with a 4-bundle structure of the xylem of a perennial stem. Other species occupy an intermediate position between the most primitive and progressive species.

Many aspects of the morphological and anatomical structure of the root, patterns of formation and growth, diversity and modification, classification and evolution, ecology and the role of the root system in the relationship between the components of plant communities are described in detail in the book by I.O. Baitulin “Fundamentals of rhizo- logy” [5].

The available anatomical reports [1,6] indicate that the stems and roots of cloves can have both normal and abnormal structures. A.L. Takhtadzhyan [7] notes

the polycambial structure of stems and roots in representatives of the fam. Capyophyllaceae, as well as in species of genera of other families of the order Centrospermae.

The works of B.N. Niyazov are devoted to the anatomy of Acanthophyllum gypsophiloides (Allochrusa gypsophiloides) [10,11]. D.Kh. Yukhananov [13], having studied the structure of the perennial root of 11 species of the genus Acanthophyllum (from cek.Oligosperma - A.adenophorum, A.subglabrum, A,korshinskyi, A.borsczowii, A.stenostgium; from cek.Turbinana-A. microcephalum, Plelosperma - A.knorringiana, A.sordidum, A.glandulosum; Macrostegia -A.korolkovii, A.serawschanicum; from the genus Allochrusa - A.gypsophiloides) distinguishes 5 conditional types.

Type I - "Beta vulgaris" - the structure is characterized by concentric layers of collateral bundles, sequentially arising from the meristematic foci of the peripicle. This type of structure, according to D. Kh. Yukhananov, is inherent in A.glandulosum from sec. Pleiosperma and A.korolkovii from sec. macrostegia.

Type II - asteroid is characterized by concentric layers of separate radial groups of bundles arising from the meristematic foci of the pericycle and located around the central part of the root. The latter, according to D. Kh. Yukhananov, is observed in A. adenophorum, A. subglabrum, A. korshinskyi. A, borsczowii from sec. Oligosperma and A. knorringianum from cek. Pleiosperma

Type III - mixed: a concentric ring of collateral bundles appears around the central part of the root, and then a layer of groups of radially located bundles is formed from the pericycle to the periphery. The root of A.sienosiegium (cek. Oligosperma) has this structure.

Type IV - with "inverted bundles": as a result of incomplete development, the part of the bundles of the radial group facing the center is, as it were, in an inverted state. This root structure is observed in sections Macrostegia - A.serawschanicum and Paniculata - A.gvpsophiloides.

Type V is a “normal” secondary structure: it is characterized by clear annual growths of wood with a large number of mechanical tissues, with a developed bast

part and wide radial bunches. Such a structure of the root was noted in the section Turbinaria - A. microcephalum, Pleiosperma - A. sordidum.

The author considers the type "Beta vulgaris" to be the original only on the grounds that all species characterized by it are at the beginning of each section according to the B.K. Shishkin [13], with which we do not agree.

We have studied the anatomical structure of perennial roots of 17 species of p.Acanihophyllum, - 2 species of p. Kughitangia and 3 species p. Gypsophila. The vast majority of the studied species of the first two genera have a concentric, polycambial root structure. A distinctive feature of the roots of the considered species (with the exception of the species of the sec. Turbinaria and A. sordidum from the sec. Pleiosperma) is the absence of mechanical lignified tissues in the xylem. Only the walls of the vessels become lignified, all other tissues are living with non-lignified cellulose membranes.

In the structure of the roots of various species, we have established 5 conditional types of xylem.

I. The type of "normal tree structure" - is characterized by vessels of secondary origin with a diffuse arrangement of gaps in the annual growths of xylem. This type includes two subtypes. The first is represented by a large number of vessels of sclerified xylem. As is known, a similar subtype of structure is characteristic of most woody plants. The second subtype differs from the first in sparsely located vessels, but in a highly developed parenchyma.

II. Type "mixed A" - around the central part of the root there is a concentric cola of collateral bundles. Then, towards the periphery, a layer is formed from the pericycle from groups of radially arranged bundles. The root of A. surtosteium (cek. Oligosperma) has this structure.

III. Type "mixed B" - in the first 3-4 years around the central part of the root, rings are formed from individual concentric bundles of xylem, then from the pericycle - large concentric bundles located along the ring. Each fascicle consists of groups divided radially into individual closely spaced fascicles surrounded by a common phloem. Each of them, in turn, can be divided radially and tangentially

due to an increasing increase in the size of the bundles (A.elatus, A. stenostegium from sec. Oligosperma)

IV. Type "asteroid" - characterized by the arrangement of concentric bundles in a ring around the central part of the root, annually arising from the meristematic foci of the pericycle. This type of structure was found in sections of Oligosperma in A. albidum.

V. The type with "inverted bundles" - is characterized by the location of part of the bundles of the radial group, facing the center, as if in an inverted state. Such a root structure is characteristic of sections Macrostegia - A.serawschanicum and Paniculata - A.gypsophiloides.

Thus, the following conclusions can be drawn:

In the genus Acanthophyllum, an atypical phellogen is laid in the annual stem, and the cork is formed from perivascular fibers, which is also repeated in the perennial stem.

The conductive system in species of one and perennial stems of species of the section Turbinaria and Pleiosperma - A.sordidum has a continuous spiked structure with clear boundaries of annual growths, characteristic of trees. In other species, the annular structure is broken and passes to the beam structure. From the 2nd - 5th year of vegetation, depending on the species and group of species.

In the stem of species p. Gypsophila phellogen is formed only in 2 species G.krascheninnikovii and G. Diffusa - only at the 2nd year of life, in other species phellogen is absent, which differs sharply from the genus Acanthophyllum, but the transformation of perivascular fibers into a cork approaches with other studied genera.

It can be assumed that the type of “normal secondary structure” of the root is the initial one among the studied taxa, since the species characterized by it have a continuous ring structure of the xylem with a developed mechanical tissue.

“Mixed type A” is considered by us to be derived from the type of “normal structure”, Our assumption is confirmed by the example of A.pungens and A.cyrtostegium, where the type of “normal secondary structure” in the course of

ontogenesis is replaced by “mixed type A” (beam)

Most of the studied species of Acanthophyllum and the genus Kughitangia are characterized by an “asteroidal” type of root structure, which, in all likelihood, originates from “mixed type A” due to the increasing transformation of the annular xylem into a bundle structure due to reductions in the annular cambium and development of the ray parenchyma.

The type "with inverted beams" arose, apparently, from the "asteroid" type as a result of the incomplete development of the upper part of the normal beams.

The "normal" type of structure of the root and stem of a continuous ring structure in A. sordidum shows that it is evolutionarily close to the species of sections Turbinaria, although it is included in sec. Pleiosperma.

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