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Morpho-anatomical structure of the leaf and bracts of some plants of the Genus Acanthophyllum C.A. Mey

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ABSTRUCT

The morphological and anatomical structure of the leaves of some plant species of the *Genus Asanthophyllum C.A. Mey* living in different habitats was studied and analyzed. We have studied the morphology of leaf hairs of 25 plant species, many of which were taken from 2-4 geographical points of their range, in order to determine the influence of environmental conditions on the type, morphology, and degree of drooping.

As a result of the research, the following conclusions were made, in species *A korshinskyi*, *A.borsezowii*, *A.elatius*, *A.cyrtostegium* common in deserts and sec. *Turbinaria* - bare leaves are formed in Kopetdag, that the leaves of *A.albidum*, *A.subglabrum*, *A.tenuifolium*, *A.stenostegium*, *A.adenophorum*, *A.krascheninikovii*, *A.brewibracteatum*, *A.aculeatum*, *A.borsezowii*, *A.serawchanicum*, *A.coloratum*, *A.jarmolenkii* are pubescent only with simple hairs, and in *A.pungens*, *A.lilacinum*, *A.pulchrum*, *A.korolkovii* the leaves are pubescent with both simple and glandular hairs and trichrome. The shown differences of plants are associated with the ecological conditions of the place of growth.

Keywords: species, morphology, anatomy, leaf, epidermis.

INTRODUCTION

One of the adaptive features of the leaf is the reduction in size, which is carried out not only due to their length, but also mainly due to a decrease in the evaporative surface of the leaf, which is especially characteristic (Ruzmatov *et al.* 2022; Duschanova *et al.* 2023) of the leaves (Albert, S & Sharma, B. 2013) of the taxa (Hong *et al.* 2018) we studied. As V.K. Vasilevskaya (1965), rapid differentiation of leaf tissues with a short period (15-25 days) and slow growth is a characteristic (Zoric *et al.* 2012; Duschanova *et al.* 2023) feature of xerophytes. In our objects, while maintaining fairly long leaves, the photosynthetic part of the mesophyll - chlorenchyma and, accordingly, the number of vascular bundles decreased in the process of evolution (Nurmahanova *et al.* 2023): from 6-7 at the base of the leaf to one at its top. The leaf trace is single-tufted, single-lacunal.

A.A.Butnik et al. (2009) believe that the *pycnophilic* (gr. picno - dense), *sclerophilic* (gr. sclero - hard), succulent (lat. Succos - juicy) groups have a fundamental difference. The terminology of these three groups is ambiguous in etymology. The term "succulents" is generally accepted, so the authors did not change it. In their opinion, pycnophilic species have a more or less developed leaf blade, various kinds of protective adaptations that reduce transpiration (pubescent, submerged stomata (Ruzmatov *et al.* 2022), thickened outer walls, more often and an isolateral-palisade type of mesophyll). Their midrib, sometimes lateral, may be sclerified by thickening of the phloem parenchyma. The listed signs of xeromorphism also have sclerophylls. The term "sclerophyll" (*sclerophylly*) was proposed by A.F.Schimper, who defined them as plants (Ariano *et al.* 2023) with hard leaves, in contrast to succulents and small-leaved xerophytes - pycnophilic plants according to A. A. Butnik et al. (2009).

V.K.Vasilevskaya (1965) and S.Ghaffari, (2004) noted the insufficiently clear characterization (6) of the ecological type of sclerophytes. We, following A.A. Butnik et al. (2009), believe that the criterion for the sclerophilic type can be the sclerenchymal sheath of procambial origin, surrounding the main and more or less large lateral veins and often occupying a large area of the leaf (Takada, Sh & Iida, H. 2014), although scleromorphic leaves at the first stages of initiation are formed in the same way as succulent ones.

Cells of the leaf epidermis (Duschanova et al. 2023) in transverse section are tangentially oblong or oval, less often - square or rounded. The leaves of all studied taxa (Abe et al. 2003) are *Amphistomatous* the stomata (Ruzmatov et al. 2022) in most species (Pirani et al. 2013) are slightly below the level, or at the level of the epidermis (Basiri Esfahani et al. 2011). Different types of stomata occur on one side of the leaf, although the diacytic type predominates.

LITERATURE REVIEW

For a long time, researchers believed that not only the species, but also larger taxa are characterized by one specific type of stomata (Lacaille-Dubois et al. 2010), however, in the works of E.A.Miroslavova, J.A.Inamdar, M.Gangadhara, P.G.Morge, R.M.Patel showed that they also noted the presence in the fam. Chenopodiaceae anomocytic and paracytic types of stomata. In species of the family *Chenopodiaceae* studied by A.A. Butnik et al. (2009), anomocytic hemiparacytic and paracytic types predominate. The authors attribute the predominance of anomocytic stomata in leaves to less specialized mesophyll types.

T.A.Madumarov (2005), who studied the anatomical structure of the leaf organs of eight species (Albert, S & Sharma, B. 2013) of thorns, showed the presence of both glandular and simple trichomes in their pubescence. Unfortunately, these authors' data refer to species taken from only one point of their range for each species. Therefore, it is difficult to judge the influence of various environmental conditions within the range of the species on the development of pubescence.

MATERIALS AND METHODS

We have studied the morphology of leaf hairs of 25 plant species, many of which were taken from 2-4 geographical points of their range, in order to determine the influence of environmental conditions on the type, morphology, and degree of drooping.

Section *Oligosperma. A.punqens.* The morphology of hairs was studied in plants taken from 4 points of its range: the Kaldzhar valley of East Kazakhstan (Zhailybayeva et al. 2024), the southwestern slope of the Dzhungar Alatau, the valley of the river. Surkhadarya and surroundings of Baysun (1200-1300 m above sea level).

The leaves of plants from East Kazakhstan are pubescent with short (80-90 microns), simple hairs of medium density (90-120 per mm^2), mixed with relatively rare (20-25 per 1 mm^2 and the same short glandular hairs of a stalked-capitate shape. It should It should be emphasized that despite the relatively large number of hairs per unit area due to their small length, pubescent hairs look sparse. Pubescent of medium density (100 per 1 mm^2) with extremely short (15-50 microns) simple unicellular hairs from narrow to wide diameter. Only on the upper epidermis, there are rare single stalked-capitate glandular hairs. In the distribution of this species in the Dzungarian Alatau (1800-2600 m above sea level) developed mountain-steppe vegetation, forest-meadow-steppe zone of the middle mountains (Zhailybayeva et al. 2024). These places are more or less adequately supplied with moisture, which causes the leaves to droop with short simple unicellular hairs and very sparse glandular hairs.

Herbarium specimens from the basin of the river. Assy, as well as the surroundings of Ak-Kul of South Kazakhstan, are pubescent with relatively dense (130 per 1 mm^2) on the upper and almost 2 times less (70-80 per 1 mm^2) - lower epidermis, but longer (100-400 microns) 2- 4-cellular simple hairs, most of which (especially on the upper side of the leaf) are constricted. The development of relatively long hairs, which form a medium-density coating of the leaf surface, especially on the upper side, is due to the more xerophilic conditions of the area and insolation (southern slopes of Karatau). This is explained by the fact that the western humid air currents, not lingering in the low mountains (24), penetrate far into the mountains, which are locked in the east by the largest mountain heights (Fergana and other ranges). As a result, there is little rainfall throughout the year.

Table 1. Classification of values of signs of leaf structure

1.	The thickness of the leaf blade, microns	Extremely thick	More 350
		Very thick	200-350
		Thick	200-250
		Moderately thick	150-200
		Thin	100-150
		Very thin	50-100
	Pubescent, number of hairs	Very thick	40-50
		Thick	30-39

2.	per 1 mm^2	Moderately thick	20-29
		Rare	10-19
3.	The number of stomata per 1 mm^2	The most numerous	More 450
		Extremely many	350-400
		So many	300-350
		Many	250-300
		Moderately much	200-250
		Few	150-200
		Very little	100-150
4.	The number of epidermal cells per 1 mm^2	Extremely small cell	1440-1540
		Small cell	1340-1140
		Moderately small cell	1140-1240
		Large cell	1040-1240
		Moderately small cell	940-1040
		Very large cell	840-940
		Extremely large cell	740-840
		The largest cell	640-740

In plants (Winnie, R. 2022) obtained from the vicinity of Baysun (Hissars Range), as from East Kazakhstan, the leaves are densely (120-190 per 1 mm^2) pubescent with short (60-70 microns) 1-2 cellular simple bristly hairs, mixed with the same short capitate glandular. Despite the development of large numbers of hairs, due to their small length, they do not create a noticeable coating, and the leaf surface remains almost bare. The reason for this phenomenon, of course, is the presence of a sufficient amount of precipitation, so on the southern slopes of the Gissar Range, where the Boysun Mountains go, up to 500-800 mm of precipitation falls annually, the main amount of which falls on February-May.

The leaves of plants from the northern slope of this ridge are more densely pubescent with simple, relatively long (130-170 microns) 1-2-celled hairs.

The location of the epidermal cells in all the studied specimens is slightly ordered, the cell walls are sinuous, with the exception of the cells of the lower epidermis - clearly ordered, the cells are narrow, elongated along the long axis of the leaf.

The epidermis of the leaf of plants from the vicinity of Baysun, the Kaldzhar valley of East Kazakhstan and the southern slopes of the Dzungarian Alatau is very small-celled (1360-1430 per 1 mm^2), from the Balkhash-Alakul depression it is moderately large-celled (950-1000), the stomata in all samples at the poles have a T-shaped thickening. About 20% of stomata are anomocytic, about 80% are diacytic. It should be noted that most of the stomata of the lower leaf epidermis of plants from the Balkhash-Alakul depression are surrounded by four cells - two pole and two lateral, similar to the stomata of monocots, a sign of displacement. There are many stomata (280-350 per 1mm^2).

The mesophyll of the leaf from the northeastern spurs of the Dzungarian Alatau is more or less reduced and makes up about 30-35% of the area of the transverse section of the leaf; the rest is vascular bundles with sclerenchyma. The mesophyll in the wings is isopalisade structure, consists of 2-6 rows of densely arranged short palisade cells. On the abaxial side of the leaf, *chlorenchyma* under the epidermis is single-layered; its cells (Ghaffari, S. 2004) are tangentially oblong and smaller than the cells of the epidermis. The conducting system in the middle of the

leaf is 3-fascicular-median with a strongly developed sclerenchyma sheath and two small lateral ones with sclerenchyma on the abaxial side.

In plants from the Balkhash-Alakul depression (Southern Betpakdada) of Kyzylkum, Karakum, the leaves are larger than in plants from the Dzhurgan Allatau, without noticeable wings, the plants themselves are cushion-shaped (hemispherical) in shape. The conductive system of the middle part of the leaf consists of five bundles - a large median and four lateral (lateral), arranged vertically (one above the other) in two. Their total area with mechanical tissue is 40-50% of the cross-sectional area of the sheet. The rest -50-60 % is chlorenchyma, formed from 4-5 layers of palisade cells, the innermost layers, which are relatively smaller than the outer ones.

We studied *A.lilacinum* plants from two places on the dry slopes of the Central Kopetdag (Sulukli) and rocky slopes of the Turkestan Range. In plants from the Kopetdag, the leaves are pubescent with numerous (220-270 per 1 mm^2) (from 5 to 120 microns in length) simple 1-3 cell hairs mixed with a small number of the same short stalked - capitate glandular hairs. Thus, the pubescent leaves of this species are similar to those of the representatives of the previous species, but differ sharply from the first in morphology (Butnik et al. 2009; Vasilevskaya, V. 1965): simple hairs are very thin-walled, slightly curly. Among them, there are many constricted ones, in most of them, the knitting cell is vesiculate-expanded, the terminal narrow needle-shaped.

The leaves of plant specimens from the southern and southwestern slopes of the Turkestan Range are densely pubescent (210 per 1 mm^2) with long thick-walled 2-5 celled simple hairs. They consist of both cylindrical and cone-shaped, which, entwined with each other, form a relatively thick coating. As noted by N.Gvozdetsky and Yu.Golubchikov (Ruzmatov et al. 2022), in the mountains of the Gissar-Alai system, an important factor in landscape differentiation is the influence of slope exposure, which is well manifested precisely in the northern slopes of the Turkestan (as well as Altai) ridge. Beautiful juniper forests grow on its northern slope. The southern slope is extremely poor in vegetation; bare rocks and scree are covered with a dark desert tan. This indicates that on the southern slopes of this ridge, where the studied plants grow, there is a small amount of precipitation, and a thick hairy covering, as is known, serves as a reliable protection both from excessive evaporation and from solar radiation. Their semi-creeping form of growth also evidences it.

RESULTS AND DISCUSSION

The epidermis is extremely large-celled (800-900 per 1 mm^2, the arrangement of cells is poorly ordered, the outlines of the cell walls are finely wavy, the cells are slightly oblong along the long axis of the leaf. There are moderately many stomata (210-230 per 1 mm^2), 20-25% anisocytic, sometimes there are separate anomocytic stomata.

Thus, the following conclusions can be drawn from the above:

- In species *A korshinskyi, A. borsezowii, A. elatius, A. cyrtostegium* common in deserts and sec. Turbinaria - in Kopetdag naked leafing is formed.
- Leaves of *A. albidum, A. subglabrum, A. tenuifolium, A. stenostegium, A. adenophorum, A.krascheninikovii, A.brewibracteatum, A. aculeatum, A. borsezowii, A. serawchanicum, A. coloratum, A.jarmolenkii* are pubescent just simple hairs.
- *A. pungens, A.lilacinum, A.pulchrum, A.korolkovii* have pubescent leaves and they are simple and glandular hairs and trichomes .

In the following series of studies, we studied the morphological features of the bracts of these plants (Vasilevskaya, V. 1965).

Recently, a number of researchers have paid great attention to the study of morphological, biological features, as well as systematic features of the main saponin-bearing representatives of species of the *Caryophyllaceae* family with a very high content of saponin. The Central Asian region is considered the only one in the world where these families meet.

Sections of the genus *Acanthophyllum* (Inamdar et al. 1977; Madumarov, T. 2005), it turned out that on the basis of the studied species, they cannot be distinguished by the anatomical and morphological (Petrishina et al. 2022) features of the leaf, but they can be characterized by features of the flower. *Oligosperma* differs from the other two sections in the absence of glandular hairs on the calyx and relatively wide (1 - 3 mm) corolla petals. However, according to other indicators, this section turned out to be heterogeneous, and it contains 2 groups of species more similar in terms of the studied characteristics: *A.pungens* - *A.albidum* - *A.leucanthum* and *A.elatius* - *A.borsczowii*. *A.glandulosum* (sec. Pleiosperma) stands out among the representatives of other sections with a large number of simple and glandular hairs on the outer epidermis of the calyx. *A.korolkovii* and *A.serawschanicum* from *cek. Macrostegia* differ greatly in most features of the leaf (Madumarov, T & Dariev, A. 2020) and flower, and for a number of characters the first of them tends to sec. Oligosperma, in particular to its species *A.elatius*. Characteristics of two species of the genus *Allochrusa* and the 11th genus *Acanthophyllum* (Matyunina, T., & Musaeva, M. 1979), including eight - the anatomy and morphology of the leaf and flower, and six - the seed showed that these taxa are clearly distinguished by a number of characters.

T.Madumarov & A.Dariev (1987) studied the anatomical structure of the leaf and flower of the genus *Kughitangia Ovcz* due to its systematic position. T.A. Madumarov's Ph.D. Based on the obtained data on the spermoderm and leaf organs, the author distinguishes the studied taxa. Species *A.albidum*, *A.brevibracteatum*, *A.aculeatum*, *A.pungens*, *A.kraschenninikovii*, *A.stenostegium* he considers as independent. Given the extreme similarity between themselves, *A.coloratum* and *A.korolkovii*, he proposes to include them in the subgenus *A.Platypyllum* Zak.et Muss. p. *Acanthophyllum.* As evidenced by the data of literary sources, the signs of the morphological and anatomical structure (Tomilova, L. 1982) of leaf organs make it possible to distinguish between species, less often genera. Z. Artyushenko came to the same conclusion when studying the leaf organs of representatives of *p.Grinum* (Krstic 2008).

The studied taxa have small (length 05-15 mm, width 1-7 mm) linear-lanceolate bracts with a pointed apex, with the exception of *A. coloralum* and *A. korolkovii* with obtuse bracts, tubular or cylindrical calyces with triangular spiny teeth. Bracts 4-10 mm long, 1-3 mm wide with a spiny apex (except cek characterize *Acanthophyllum* (together with *p. Kughitangia Macrostegia*), pubescent mainly with simple 1-3-celled hairs.

Linear-lanceolate or linear-awl-shaped bracts 7-10 mm long and 1-3 mm wide characterize types of sec. Oligosperma. The largest bracts belong to two species - *A. pungens* and *A. adenophorum* (respectively, 7-9 mm long, 2-3 mm wide and 9-10 mm long, 0.8-1.5 mm wide), small - in *A albidum, A. kraschenninikovii, A. aculeatum, A. pulchrum, A. leucanthum* and *A. cyrtostegium*. Other species on this basis occupy an intermediate position between the data of the two groups. Sec. *Turbinaria* is characterized by the smallest (length 4-5 m and width 1-1.5 mm) bracts in the genus *Acanthophyllum*.

Bracts sec. Pleiosperma is of medium size (length 5-7 mm and width 2-2.5 mm). Of the three studied species of this section, *A.glandulosum* has the largest bracts (length 6-7 mm, width

2-2.5 mm). Representatives of the Macrostegia differ in the same length (length 5-6 mm, width 1-2.5 mm), obversely broadly ovate (*A.coloralum*, *A.korolkovii*) and linear-lanceolate (*A. serawschanicum*) bracts.

In this section, the largest bract is A.korolkovii: length 5-6 mm, width 2-2.5 mm. The genus *Allochrusa* differs from others in the smallest (up to 1 mm long and 0.5 mm wide), somewhat reduced linear-subulate and non-spiny bracts, and the smallest: their thickness (70-80 mm). The genus Drypis has lower and upper completely bare, broadly ovate large bracts (lower ones 13-14 mm long, 6-7 mm wide, upper ones 9-10 mm long, 4-5 mm wide) with 6 teeth located 3 on the sides, which differs sharply from the other two genera. These teeth (processes) are reduced lateral lobes of the former once wide plate, which is confirmed by the presence of a conducting bundle in their lower half. The studied representatives of the genus Gypsophila are characterized by the smallest (length 0.5-1 mm) bracts. The classification of the values of the signs of the structure of the bracts and sepals is given in Table. 2.

Table 2. Classification of values of signs of the structure of bracts and sepals

Length, mm	Extremely long	More 14
	Very long	12-14
	Long	11-12
	Moderately long	8-10
	Short	6-8
	Very short	4-6
	Extremely short	0,3-3
Thickness, microns	Extremely thick	339-390
	Very thick	295-338
	Thick	251-294
	Moderately thick	207-250
	Thin	163-206
	Moderately thin	118-163
	Very thin	94-117
	Extremely thin	50-93
Pubescence, number of hairs per 1 mm2	Exceptionally thick	More 300
	Extremely thick	251-300
	Very thick	201-250
	Dense	151-200
	Moderately thick	101-150
	Rare	50-100
	Very rare	Before 50
Number of epidermal cells per 1 mm2	Extremely small cell	1347-1467
	Very small cell	1226-1346
	Small cell	1105-1225
	Moderately small cell	984-1104
	Moderately large cell	864-983
	Large cell	742-862
	Very large cell	621-741
	Extremely large cell	500-620

Number of stomata per 1 mm2	So many	301-358
	Many	251-500
	Moderately much	200-250
	Few	151-200
	Very little	101-150
	Extremely few	50-100

In plant taxonomy, the structure and distribution of epidermal outgrowths are of great diagnostic importance (Madumarov, T & Dariev, A. 1987). If the density of pubescence can vary significantly depending on the phase of development and the ecological conditions of the habitats, then the shape of the hairs is genetically determined and is less affected by the environment and, therefore, is a reliable taxonometric feature.

The bracts of all representatives of the genus Acanthophyllum are relatively densely pubescent with simple single-beam, consisting of 1-3 cells, trichomes 97-112 microns long. Of the 13 species studied, sec. *Oligosperma* are pubescent only with simple hairs, and only two species - *A. lilacinum* and *A. pulchrum* - are simple and glandular. The species of other sections are pubescent, like the last two species, with hairs of both types. In sec. *Oligosperma* two species - *A.adenophorum* and *A.kraschenninnikovii* - have the largest number of hairs - 130 per mm^2. *A.albidum, A.brevibracteatum, A.aculeatum* have relatively sparse hairs - 100 per mm2. In other species, their number per 1 mm^2 does not exceed 80. Among the representatives of this section, *A.albidum* and *A.kraschenninnikovii* stand out with the longest (130-192 microns) hairs and *A.adenophorum* with relatively long (152-163 microns) *A.aculeatum, A.pulchrum, A.brevibracteatum and A.lilacinum*. In other species, their length is in the range of 112-114 microns. It should be noted here that *A.albidum, A.aculeatum* and *A.brevibracteatum*, considered by a number of researchers as synonyms of the species A.pungens, as well as *A.stenostegium* - of the species *A. kraschenninnikovii*, differ markedly from each other in the main indicators of the structure of the bracts. For example, in A.aculeatum it reaches 110. *A.stenostegium* differs from *A.Kraschenninnikovii* in a smaller number of epidermal cells per 1 mm^2 of area than in the latter, a greater thickness of the cross-section of the bracts, and almost two times fewer simple hairs (80 versus 130 mm^2 - on the outer and 80 versus 125 - on the inner structure of the bract). All this speaks in favor of the opinion of A.I.Vedensky on the independence of these species (1).

Views from sec. *Turbinaria* are pubescent on both sides, simple, mixed with stalked-capitate and glandular hairs from medium density (60-80 per 1 mm^2) to dense (100-140). Bracts sec. Pleiosperma on the inner side are pubescent in clusters (152-180 per mm^2) simple mixed with sparse (50-60) stalked-capitate glandular hairs, on the outer surface - the same trichomes of moderate density (100-150 per 1 mm^2) Species sec. *Maciostegia* covered with moderately dense (100-150) simple and glandular hairs on the inner side, while on the outer side - with dense (156-200) simple and moderately dense (100-140) glandular hairs. The bracts of K.Popovii are pubescent from above with simple sparse (25-30 per 1 mm^2) mixed with stalked-capitate (35-45 per 1 mm2) glandular hairs. In K.knorringiana they are naked, although in the "Flora of the USSR" their pubescence with glandular hairs is noted.

In the genus *Allochrusa*, the bracts of *A.paniculata* are pubescent with simple hairs, while those of *A.gypsophiloides* are completely naked. The bracts of the genus Drypis lack any trichomes.

All studied taxa are characterized by amphistomatic bracts, however, stomata are absent on the lower half of the inner surface in contact with the calyx. The stomatal apparatus is mainly anomocytic (the stomata are surrounded by four secondary cells), less often - diacytic and anisocytic. Stomata of medium size - 32-40 microns long and 20-30 microns wide - are located below the level of the outer wall of epidermal cells, which is typical for xerophytes.

Within the genus *Acanthophyllum*, sec. *Turbinaria* (360 per 1 mm^2 of the area of the outer epidermis and 280 per 1 mm^2 of the inner epidermis), the smallest (110-189 per 1 mm^2 on the outer and 100-150 on the inner epidermis) - species of sec. *Pleiospenna*. Types of sec. Macrostegia in this indicator occupy an intermediate position between the two previous sections (205-220 per 1 mm^2 on the outer and 140-200 on the inner epidermis). In sec. *Oligosperma* the smallest number (80 per 1 mm^2) of stomata are characterized only by A.pulchrum, the average number (105-130) - *A.lilacinum, A.adenophorum, A.brevibracteatum, A.leiostegium, A.cyrtostegium*, the largest number (200) - *A.krascheninnikovii*, in other species, the stomata section per 1 mm2 does not exceed 160-180 on the outer and 140-180 on the inner epidermis. Large stomata (40 μm long, 25-30 μm wide) are characteristic of *A.brevibracteatum* and A.aculeatum species, while others are of medium size (32-38 μm long, 22-30 μm wide). *Sec. Turbinaria* is distinguished in the genus by the smallest (length 24 microns, width 18 microns) stomata, *Pleiosperma* - relatively large (length 37-45 microns, width 23-25 microns). Types of the same sec. *Macrostegia* on this basis are between sec. *Oligosperma* and *Pleiosperma*, but still closer to the latter. The smallest stomata (40-70 per 1 mm2) are characteristic of p.Kughitangia species.

The subspecies and ecological forms of the monotypic genus Drypis differ somewhat in the number of stomata, especially the large difference between subspecies and the relatively small difference between ecoforms. For example, in *D.spinosa ssp-spinosa* (Zhou, X., Lu, X & Wang, X. 2022) on the outer epidermis, the number of stomata is 150-165 per mm2, in *D.spinosa ssp-jacquiniana* - 120 with larger sizes than in the first subspecies. On the inner epidermis, the number of stomata is the same in both subspecies, but they differ markedly in size. All this testifies on the one hand to their differences between them. In terms of the size and number of epidermal cells, the bracts of the genera under study are generally classified as very large-celled and extremely large-celled (600–980 mm^2 on the outer and 500–898 mm^2 on the inner epidermis) with the exception of sec. *Turbinaria*, whose bracts are extremely small-celled (on average 2370 per 1 mm^2 on the outer and 2100 on the inner epidermis), which puts it in a separate position in the genus *Acanthophyllum*.

It should be noted that the most large-celled epidermis is characteristic of the lower part of the inner surface of the bracts (400-680 per 1 mm^2). In representatives of *Acanthophyllum*, this zone forms a tube and therefore touches, i.e. pressed against the calyx and has no stomata, while in the genera *Allochrusa* and *Drypis* the bracts immediately fold outward and do not form a tube.

Sec. Oligosperma of the genus *Acanthophyllum* has a large-celled (740-890 per 1 mm^2) outer epidermis, very large-celled (660-695) and large-celled (716-798) inner epidermis. *A.albidum, A.brevibracteatum, A.borsczowii, A.leucanthum* and *A.cyrtostegium* stand out in the relatively large-cell section (740-760n on the outer and 650-700n on the inner surface) epidermis. Other species have 1 mm^2 850-890 on the outer and 730-820 on the inner epidermis. Sec. *Pleiosperma* is characterized by very large-celled '(600-709) outer and inner, Macrosteaia - moderately large-celled (915-980) outer and large-celled and moderately large-celled (800-

898) - inner epidermis. In the genus Drypis, in the subspecies jaquiniana, the epidermis of the bracts is extremely large-celled (550 on the inner and 600 on the outer), while *in ssp. spinosa* the outer large-celled (765-850), the inner extremely large-celled and very large-celled (500-700).

In terms of the thickness of the bract plate, there are more differences within the genus than between genera, which does not allow one to characterize the studied genera as a whole.

The bract plate in *Oligosperma* species is thick to very thick (251-320). Among the species of the same section, only in *A.kraschenninikovii* it belongs to the class of moderately thick (235 microns), in *A.pungens, A.lilacinum, A.albidum, A.adenophorum, A.elatius* - very thick (300-320 microns), in others - thick (260-295 microns).

Types of sections *Turbinaria* and *Pleiosperma* according to the thickness of the plate privetnichkov similar and on this basis belong to the group of "extremely thick" - their thickness reaches 350, respectively; 365-390 microns, which indicates similar environmental conditions of their habitat. Moderately thin plates - 134-150 microns, characterize representatives of sec. *Macrostegia*. In terms of thickness, all three studied species of this section, as well as Pleiosperma species are close to each other. The bracts of p.Kughitangia are similar in thickness of 250-300 microns to *A.albidum* and *A.aculeatum*. The genus *Allochrusa* differs from the other two genera in extremely thin (70-80 μm) bracts.

Subspecies and ecoforms of the genus Drypis, like those of the Macrostegia section of the genus *Acanthophyllum*, have moderately thin bracts (116-150 μm). Both subspecies are well distinguished in their thickness. In *D.spinosa ssp. jacquiniana* it does not exceed 117 μm, in D. spinosa ssp. spinosa it is from 130 to 150 μm, depending on the place of geographical distribution. The difference between the ecoforms in the thickness of this organ, as well as in the number of cells, is greater than between some species of the genus *Acanthophyllum*, which indicates their sufficient distance from each other in terms of the features of the bract.

CONCLUSION

The genus *Allochrusa* is characterized by a 2-3-layered isopalisade mesophyll. Otherwise, the structure of this tissue is the same as that of the previous genus.

Bracts, the central vein of which protrudes more weakly than in the genus *Acanthophyllum*, while in the genus *Allochrusa* it is almost without a rib, characterize the genus *Drypis.* The central vein is immersed in the thickness of the mesophyll, differs sharply from the two previous genera in undifferentiated (into palisade and spongy parenchyma) 2-3-layer mesophyll. To a certain extent, this indicates that this part of the flower of the genus *Drypis* is relatively less advanced than in the other two genera.

1. For the studied *Acanthophyllum, Allochrusa* and *Drypis*, amphistomatism, anomocytic, considered primitive in this family, are common. *Caryophyllaceae*, more rarely *a diacytic* type of stomatal apparatus, outer cell walls with a cuticular layer, strongly protruding sclerenchymal rib of the midrib on the abaxial side of the bract plate.

2. The Mediterranean genus *Drypis* is characterized by broadly lanceolate (length 9-14 mm, width 4-7 mm), very thin (116-150 microns) bracts, having 3 subulate teeth on each side - reduced lobes, undifferentiated 3-layer mesophyll with a 3-bundle conducting system and an extremely large-celled and very large-celled epidermis without trichomes. The *jacquiniana* subspecies differs from the spinose subspecies in having the most large-celled epidermis and large stomata. All signs of the bract of this genus speak in favor of the comparatively lesser displacement of this organ than in the other two genera.

3. The genus *Allochrusa* is distinguished from others by reduced awl-shaped (length 0.5-1 mm, width 0.3-0.5 mm) and extremely thin (70-80 microns), pubescent only with unicellular simple hairs, unifascicular and unilacunal node, bracts with a three-layer isopalisade mesophyll, very large-celled (650-750 per 1 mm^2) epidermis.

4. Representatives of the genus *Acanthophyllum* differ markedly from each other in terms of the anatomical and morphological structure of this part of the flower and, therefore, none of the signs of its structure can characterize the genus *Acanthophyllum* as a whole. However, species and sections within the genus differ from each other in one way or another. For example, types of sec. *Oligosperma* unite with bract plate from moderately thick to very thick (236-320), with small-celled (740-890 microns) epidermis, sparse (70-100 per 1 mm^2), rarely moderately dense pubescence (110-130 per 1 mm^2), simple hairs and the absence of glandular hairs (with the exception of *A.lilacinum* and *A.puichrum*, which have them). *A.albidum* differs from *A.pungens* in the number of epidermal cells of the outer epidermis (792 versus 880 per 1 mm^2), simple hairs on the inner epidermis (60 versus 120) and their length (153 versus 108 microns) from two other species - *A.brevibracteatum* and *A.aculeatum*, considered as *A.albidum*, ero (*A.pungens*) synonyms. It differs in the thickness of the plate (320 μm versus 260, 257, respectively), the number of epidermal cells of the adaxial side (700 versus 680, 800), as well as the number of stomata (146 versus 110, 110 per 1 mm^2). *A.pulchrum*, like *A.lilacinum*, occupies a separate position by the presence of glandular hairs on both sides of the bract.

5. *A.Krasheninnikovi*, considered a synonym of *A.stenostegium*, differs markedly from the latter in the thickness of the plate (236 versus 290 microns), the number of epidermal cells (900 versus 700 microns), simple hairs (130 versus 30-40 per 1 mm^2) and the absence of glandular hairs.

6. Other sections of the genus differ from sec. *Oligosperma* by the presence of a bract on both sides and along with simple glandular hairs.

7. Sec. *Turbinaria* has an extremely thick (351 microns) plate and the most small-celled (2100-2370 per 1 mm^2) epidermis, small and numerous stomata (280-350) not only among representatives of all *Acanthophyllum* genera, but also other genera.

8. Sec. *Pleiosperma* has the thickest bracts (365-390 μm) among the studied taxa, very and moderately large-celled epidermis (700-709 per 1 mm^2), the largest number (150-180 per 1 mm^2) of simple hairs.

9. Sec. *Macrostegia* occupies a separate position from other sections with the thinnest (134-149 microns) bracts, large-celled and moderately large-celled (800-980 per 1 mm2) epidermis and numerous (205-220) stomata, the densest (165-200) oozing with simple hairs from the inside.

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