



THE ECOTOPE INFLUENCE ON ANATOMO-MORPHOLOGICAL FEATURES OF *ASTER AMELLUS* L.

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Abstract. The article regarded to *Aster amellus* – rare species within floristic complex of the Penza region. It is listed in the Red Book of the Penza region. The correlation was revealed between the anatomical and morphological plant structure and the environmental conditions of its habitat.

Key words: *Aster amellus*, ecotope, forest, steppe, anatomy, morphology

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Occurrence of *Aster amellus* L. in Penza region is noted both for the forest and steppe communities (IVANOV *et al.* 2002). The study of the species on the individual level allows using the received data on its vital state in the community for environment phytoindication and monitoring. In the Penza region *A. amellus* is quite rare and is a summer-green short-rhizome perennial with flowers ranging from light blue to blue-purple. The plants growing in the steppe and in the forest formations on the territory of the reserve “Volga forest-steppe” plot “Kuncherovskaya forest-steppe” were taken for analysis. Instances were collected during the flowering period (in July) and have about the same ontogenetic age. As the differential characteristics were used: length, diameter and number of shoots; length, width and number of assimilating leaves; diameter and number of inflorescences. 163 plants from the steppe ecotope and 37 plants from the forest ecotope were collected and analyzed further.

For investigations on leaf anatomy *A. amellus* took up already formed mature third leaves from the plants, to study stem anatomical structure of stem the internodes was taken between the third and fourth leaves. Preparation of sections and microscopy was carried out due to standard methods (NAUMOV & KOZLOV 1954; PROZINA 1960). As a result about 30 microslides were prepared. All the data were processed and subjected statistically (ZAITSEV 1984) what allows to confirm the accuracy of results.

Study of the influence of abiotic factors on the parameters of aster plants were performed on the model sites, laid in two formations: the steppe and forest (marge) in number of 29 and 6, respectively. Geobotanical descriptions have been completed by MIRKIN *et al.* 2001. Further these descriptions have been processed on the environmental scales by TSYGANOV (1983), using a special computer software (ZAUGOLNOVA *et al.* 1996) to assess the major environmental parameters.

In steppe formation *A. amellus* has found in the association of meadow steppe with dominated species *Bromopsis riparia* (Rehm.) Holub, *Stipa pennata* L., *Filipendula vulgaris* Moench, *Galium verum* L., *Inula hirta* L. and other. In the forest *A. amellus* is associated with meadows, forest edges with a very rarefied tree cover of birch or pine. In the grass cover there are dominated *Bromopsis riparia*, *Glechoma hederacea* L., *Dactylis glomerata* L., *Carex montana* L., *Trifolium montanum* L., *Trifolium alpestre* L., *Veronica chamaedrys* L., *Geranium sanguineum* L.

Ecological conditions analysis showed that ecotopes have similar, nearly overlapping, ranges of ecological conditions (Tab. 1). Most significantly they differ only in the richness of the soil with nitrogen and the degree of hydration. In this case, the scale of light – shading both habitats are well-lit habitats: the half-open (shrub ecological suite) – forest formations, and to intermediate between the types of open and

Table 1. Environmental assessment of investigated locations.

Locations	Values	Ecological factors					
		Hd	Tr	Nt	Rc	Lc	fH
Forest	Min	10	7	5	7	3	6
	Max	12,5	8	5.5	9	3.5	7
	Mean	11	7.5	5.17	7.83	3.17	6.67
Steppe	Min	8	6	2.5	7	2	5
	Max	10	10.5	4	10	3.5	7
	Mean	9,91	7.22	3.14	8.03	2.16	6.52

semi-open spaces – steppe formation (sublight, glade suite).

Analysis of the vegetative organs structure of *A. amellus* in different formations revealed several differences. Stems of *A. amellus* growing in the forest formation were green, upright, rounded in outline, downy with short straight hairs, woody at base; while the stems from the steppe formations – well branched with less leaves in the bottom, often the lower leaves turn yellow and die off quickly. The lower part of the stem is reddish in color.

Shoots of forest plant were almost 2 times higher than the steppe ones (49.96 ± 2.94 and 28.3 ± 0.92 cm respectively), and had smaller diameter at the level of hypocotyl (0.20 ± 0.02 and 0.14 ± 0.01 cm respectively); they also develop fewer assimilating leaves (on average 13 and 16 respectively). Thus, length of internodes in plants of steppe formations was much smaller than in forest examples.

Leaves sessile, leaf arrangement is alternate. Leaves of the plants of steppe ecotope form an acute angle with the stem. In contrast, the leaves of the plants from the forest ecotope show opposite regularity. In plants of different formations leaves vary in size and shape: in forest areas leaves are large (the average length of the leaves along the shoot ranges from 8.06 to 2.41 cm, width – 1.38 to 0.53 cm), round-lanceolate, sharply tapered base, with pointed tip, entire. While the plants from the steppe have leaves with length from 4.83 to 2.17 cm and width – from 0.9 to 0.43 cm, linear-lanceolate, with narrowed base, with toothed-pointed tip, with rare teeth on the edges.

In the axils of the upper assimilating leaves

usually lay buds enrichment (1 in plants forest formation and 1-7 – in steppe formation), and are developing well branched enrichment shoot, which ends baskets: the more numerous and larger in forest plants (8-9, with average diameter 4 cm) than in the steppe plants (5-6, and 2,5 cm respectively).

Analysis of the anatomical structure of vegetative organs of *A. amellus* showed that stem of the plants rounded in cross section, with several protrusion areas over differentiated vascular bundles, has a small number of live protective hairs formed by 4-6 cells.

The stem is covered with single-layered epidermis, the cells of which are small (in plants from steppe formations they are smaller than those of forest plants), of isodiametric type with unevenly thickened walls. Thickening exposed external tangential and radial cellular walls, internal tangentially walls less thickened compared with external tangential walls. Epidermal cells produce the cuticle outside. Protoplasts of live epidermal cells contain a small amount of chloroplasts. The epidermis has anomocytic stomata, closing cells are slightly above the cells of the epidermis. The number of stomata in plants from steppe ecotope is larger.

Under the epidermis in plants from forest formation is the primary cortex of 2-4 layers, parenchymal cells are relatively small, and contain chloroplasts. Primary cortex interrupted by angled collenchyma located above the vascular bundles as separate fragmented groups. Cortical parenchyma is gradually moving into the parenchyma stele. Endodermis is not expressed.

Under the epidermis of the plants from steppe formations primary cortex consists of 2-3 layers of parenchyma cells (some of them have small sizes) and the bottom layer of the primary cortex. Toward the stem center large thin-walled cells are located, they can be ruptured and form lenticular air cavities, which have been not observed in shoots of forest ecotope. Primary cortex has angled collenchyma. There were observed greatest number of vascular bundles.

Pericycle, separating the stele from the cortex, is presented with parenchymal cells of larger size than the parenchymal cells of the cortex and sclerenchyma. Stele is built by open collateral bundles (strongly elongated in plants steppe formations), the size and number of which exceeds those in plants from forest ecotope (of 11-15 and 10-13 bundles respectively).

Vascular bundles contain mostly secondary xylem with libriform fibers; its volume is more significant in plants of forest ecotope. Vessels are scattered throughout the secondary xylem evenly, a large number of vessels forms during the spring growth. Xylem parenchyma is weak, and mostly confined to the interfascicular part of the xylem. Due to the vigorous activity of the cambium xylem merges into a single concentric ring. Primary xylem is adjacent to the core.

Phloem in vascular bundle is less developed in comparison to the xylem. Its volume in stems of forest plants is about 1/8-1/10 of xylem volume, while in the steppe plants – 1/12-1/14. In the phloem are located thin-walled small elements: sieve tubes and phloem parenchyma. Phloem is located only in the area of vascular bundle; between the bundles at the level of phloem parenchyma is located.

The central position in the stem has the core, its parenchymal cells increase in the size centripetally. Core parenchyma has well-developed intercellular spaces and occupies about 36% of the total area of the stem transverse in the plants of forest formation, and about 23% – in the plants of the steppe formation.

Leaves of *A. amellus* growing in forest ecotope are evidently dorsiventral. They are covered with a single layer of the epidermis. Upper epidermal cells are larger than the

lower. Both sides have hairs. Upper epidermis has stomata of anomocytic type. Mesophyll differentiated into columnar and spongy tissue. Columnar mesophyll cells are adjacent to the upper epidermis in a single layer, tightly folded; its length is greater than the diameter. The lower epidermis of the leaf is adjacent to spongy mesophyll containing a significant amount of intercellular spaces (3-4 layers). Vascular tissue is represented with bundles of midrib and ribs of lateral position. Bundles are of collateral type and sharply protrude from the bottom of the leaf. Vessels in xylem are well-developed, while the mechanical elements are worse presented here. In the phloem are well represented bast fibers, in contrast to the vascular bundle of the stem. In the midrib mesophyll interrupted above and below the parenchyma and collenchyma. Lateral ribs are less developed and do not reach the cells of epidermises.

Leaves are equifacial – columnar mesophyll occurs both at the lower and the upper sides of the blades. The cells of both layers densely adjoin to each other indicating that there is sufficient light on both sides of the blade. However, at the top of the leaves from steppe plants columnar mesophyll forms two layers of cells, and the bottom – only one. In the center, between two rows of columnar mesophyll is located spongy mesophyll with large intercellular spaces.

Thus, different types of growth ecological conditions have caused essential changes in anatomical and morphological parameters of *A. amellus*. Plants in steppe formations have more expressed xeromorphic structure, the smaller shoots and internodes, as well as equifacial narrow leaves with increased number of stomata and thick cuticle.

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