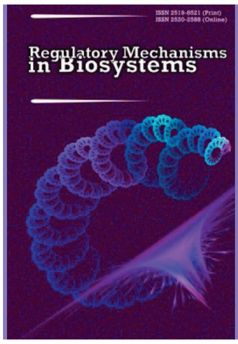

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Comparative flower morphology of *Agapanthus africanus* and *A. praecox* (Amaryllidaceae)

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The structure of *Agapanthus africanus* and *A. praecox* flowers was studied on permanent cross-sectional and longitudinal sections using a light microscope. The genus *Agapanthus* belongs to the subfamily Agapanthoideae, the family Amaryllidaceae, which is characterized by the presence of the upper ovary, septal nectaries and fruit – fleshy capsule. Micromorphological studies of the flower are considered as a way for detection of unknown plant features, adjustment of plants to specialized ways of pollination and determining the first stages of morphogenesis of fruit, and further use these features in taxonomy. 10 flowers of *A. africanus* and *A. praecox* were sectioned using standard methods of Paraplast embedding and serial sectioning at 20 micron thickness. Sections were stained with Safranin and Astra Blau and mounted in Eukitt. It was found that in the studied species the tepals have single-bundle traces. The vascular system of the superior ovary consists of a three bundle dorsal vein, of the ventral roots complex, which are reorganized into paired ventral bundles of the carpel, which form traces to ovules. For the first time, the following gynoecium zones were detected in *A. africanus*: a synascidiate structural zone with a height of about 560 μm and a fertile symplicate structural zone with a height of about 380 μm and a hemisymplicate zone of 2580 μm. In *A. praecox* gynoecium, there is a synascidiate structural zone with a height of 200 μm and a symplicate structural zone of 600 μm and a hemisymplicate zone of 620 μm. Septal nectaries appear in the hemisymplicate zone and open with nectar fissures at the base of the column, with a total septal nectar height of 2880 μm in *A. africanus* and 820 μm in *A. praecox*. The ovary roof is 300 μm in *A. africanus* and 200 μm in *A. praecox*. Triple dorsal bundles of carpels in *A. africanus* have been identified, which could be considered as adaptation of different stages of morphogenesis of fruit to dehiscence. The new data obtained by the vascular anatomy of the flower and the presence of different ovary zones significantly add to the information about anatomical and morphological features of the studied species, which can be further used in the taxonomy of the family Amaryllidaceae.

Keywords: Agapanthoideae; ovary; flower morphology; gynoecium; septal nectary.

Introduction

Molecular-phylogenetic analysis allows the division of genera, subfamilies and families, by molecular characteristics, but scientists do not always take into account such important features of flower structure as features of vascular anatomy and structure of septal nectaries, the presence and height of ovarian zones, although the basis for taxonomic systems may also be signs of flower micromorphology. The integration of data from molecular phylogenetics and evolutionary comparative flower morphology is a promising direction for the construction of modern evolutionary taxonomy. The study of micromorphology and vascular anatomy of monocotyledonous flowers and fruits is a modern direction in the study of evolutionary morphology (Odintsova & Fishchuk, 2017; Skrypec & Odintsova, 2020). Molecular-phylogenetic reconstructions of the subfamily Agapanthaceae have been carried out by many scientists Pires et al. (2006), Seberg et al. (2012), Chase et al. (2016).

The objects of our study were *Agapanthus africanus* (L.) Hoffmanns and *A. praecox* Willd. They belong to the genus *Agapanthus*, subfamily Agapanthoideae, family Amaryllidaceae (Chase et al., 2009; Chase et al., 2016). The genus belongs to the subfamily Agapanthoideae and has been the subject of debate since its inception. In the Cronquist system, the genus was placed in a very broad family Liliaceae along with other lilioid monocotyledonous plants (Cronquist, 1981). In 1985, R. Dahlgren, H. Clifford, and P. Yeo placed *Agapanthus* in the family Alliaceae, closer to the genus *Tulbaghia* (Dahlgren et al., 1985). According to them, the family Alliaceae also included several genera, which would later be transferred to the family Themidaceae. In 1996, after phylogenetic analysis of the DNA sequences of the rbcL gene, Themidaceae was returned and *Agapanthus* was removed from Alliaceae (Fay & Chase, 1996). The authors found that *Agapanthus* is a sister clade to the subfamily Amaryllidaceae and moved it to this family. The Angiosperm Phylogeny Group (APG, 1998) disagreed with this distribution when they published the APG system in 1998, as the *Agapanthus* and Amaryllidaceae clade had only 63% support. The APG system identified three separate families: Agapanthaceae, Alliaceae *sensu stricto* and Amaryllidaceae *sensu stricto*. The family Agapanthaceae included only the genus *Agapanthus*.

The second version of APG II (APG, 3003) was introduced to the world in 2003, it offered the possibility of combining Agapanthaceae, Alliaceae *sensu stricto* and Amaryllidaceae *sensu stricto*, under the common name Alliaceae *sensu lato*. Alliaceae *sensu lato* was later replaced by Amaryllidaceae for a broader understanding of the family, but the description of the family remained unchanged. When APG II was replaced by APG III in 2009, Agapanthaceae wasn't moved, but was considered a subfamily of Agapanthoideae with a broad understanding of the Amaryllidaceae family (APG, 2009). Takhtadjian (2009) refers the genus *Agapanthus* to the order Amaryllidales and the family Agapanthaceae, which includes one genus and 9 species. The order includes the three smaller families allowed by APG II, instead of combining them as in APG III (Takhtajan, 2009). Subsequent molecular phylogenetic analysis of DNA sequences confirmed that Agapanthus is a sister clade to the subfamily Allioideae and Amaryllidoideae, family Amaryllidaceae (Pires et al., 2006; Seberg et al., 2012; Chase et al., 2016). Genus *Agapanthus* L'Her.

has about 9 species of herbaceous bulbous perennials that are distributed in South Africa from the Cape Peninsula to the south of the Limpopo River (Takhtajan, 2009). Characteristic features of the genus are fleshy roots, provided with a multiple velamen. Laticifers are present in genus *Agapanthus*. Vessels are only in roots, mostly with scalariform perforations. Calcium oxalate raphides are present in the cells (Takhtajan, 2009) and the ovary is superior, inner septal nectaries present, stigma is small, fruit is a loculicidal capsule with many flat, black, winged seeds (Meerow & Snijman, 1998).

The study of the genus *Agapanthus* is relevant: assessment of fertility in horticultural selections of the genus *Agapanthus* (Dawson et al., 2018), dehydrins from *A. praecox* as protectors to improve plant cell viability during cryopreservation (Zhang et al., 2021), single-wall carbon nanotubes which improve cell survival rate and reduce oxidative injury in cryopreservation of *A. praecox* embryogenic callus (Ren et al., 2020), *in vitro* micropropagation of *A. praecox* (Baskaran & Staden, 2013) and micropropagation of *Agapanthus umbellatus* var. *minor* (Fogaça et al., 2016), voltage production in a plant-microbial fuel cell using *A. africanus* (Gómora-Hernández et al., 2019). A chromosome study in *Agapanthus* and the phylogeny of its species was performed (Sharma & Mukhopadhyay, 1963). Phytoecdysteroids in the genus *Agapanthus* have been studied (Savchenko et al., 1997). Antifungal activity of *A. africanus* extractives was performed by Indian scientists (Singh et al., 2020).

The history, taxonomy, distribution and cultivation requirements of the South African *A. africanus* (L.) Hoffmanns. were investigated by Duncan (2004). Micromorphological characterization of the leaf and rhizome of *A. praecox* subsp. *praecox* Willd. have been studied by Sharaibim & Afolayan (2017). There have also been studies of fertilization and embryogeny in *A. praecox* ssp. *orientalis* (Zhang et al., 2011), flower development and senescence-related changes in *A. africanus* (Gören Sağlam et al., 2011), flower development and anatomy of *A. praecox* ssp. *orientalis* (Zhang et al., 2011), anticholinesterase and mutagenic evaluation of *in vitro*-regenerated *A. praecox* grown *ex vitro* (Baskaran et al., 2014), gibberellin and auxin signals control scape cell elongation and proliferation in *A. praecox* ssp. *orientalis* (Yue et al., 2016).

Therefore, the issues of taxonomy and *in vitro* micropropagation, fertilization, embryogeny and flower development of the genus *Agapanthus* have attracted considerable attention from modern researchers, but the issues of vascular anatomy of the flower, the gynoecium structure remain poorly studied. The aim of our study is to elucidate the flower morphology features and the internal structure of the gynoecium and identify its vertical zonality in members of the family Amaryllidaceae for further using them in the taxonomy of the family.

Material and methods

Ten *A. africanus* and *A. praecox* flower buds were collected in the agricultural station of Lesya Ukrainka Volyn National University and fixed in 70% alcohol. Flower buds were dehydrated in t-butanol series (20%, 30%, 50%, 70%, 100% – 2 h each, the last one 24 h) and stored in 100% t-butanol and paraplast in the ratio 1:1. Infiltration was performed in Paraplast (Merck®) according to the described method (Barykina et al., 2004). Transverse and longitudinal sections thickness were obtained with manual rotary microtome, the thickness of the slide is 20 µm (MPS–2, USSR). Then it stained in Safranin (Sigma-Aldrich®) and Astra Blau (Merck®). Slides were mounted in “Eukitt®” (Sigma-Aldrich®) and images were made with an Amscope 10MP digital camera attached to an Amscope T490B-10M (USA) microscope.

For the morphological analysis, measurements were made on at least 15 fresh *A. africanus* and *A. praecox* flowers. The concept of gynoecium vertical zonality by Leinfellner (1950) was used to analyze the gynoeciaum's internal structure. This concept considers only the congenital fusion of the carpels. The congenital multilocular synascidiate, unilocular simplicate, transitional hemisimplicate, and asymplicate zones could be formed in the syncarpous gynoecium according to this concept when carpels are grown together. In terms of incomplete fusion of carpels, only in their outer part do they form a hemisyncarpous gynoecium with hemisynascidiate, hemisimplicate, and asymplicate zones; later, this method was improved for monocots (Odintsova, 2013). According to the number of cross-sections ehe height of the zones of gynoecium was measured.

Results

The flower of *A. africanus* is up to 3.0–3.4 cm long, light blue in colour and has a very strong aroma. The scape is 50–77 cm long and 0.9 cm in diameter at the base and 0.7 cm in diameter above. The pedicel is 1.8–2.0 cm long, 0.1 cm in diameter (Fig. 2a, b). The perigonium forms a flower tube 1.8–2.0 cm long and 0.40–0.45 cm in diameter at the base. The outer tepals are 1.8, 1.8, 1.9 cm long and 0.5, 0.4, 0.5 cm wide. The inner tepals are 1.7, 2.0, 1.8 cm and a width of 0.8 cm, respectively. (Fig. 2h). The flower tube and perianth leaves in the middle have dark blue stripes (Fig. 2d, g).

External and internal stamens are directed in one direction. The stamens of the inner circle are 1.9, 1.9, 1.8 cm long and 0.075 cm in diameter, and the stamens of the outer circle are 2.0, 1.8, 1.9 cm long and 0.05 cm in diameter (Fig. 2h). Filaments are light blue (Fig. 2h). The anthers are linear, anthers on outer stamens are 0.15 cm long and 0.10 cm in diameter, anthers on inner stamens are 0.10 cm long and 0.05 cm in diameter, they are attached to the stamen filament below the middle of their height. *A. africanus* ovary is superior (Fig. 1a), three-loculed, elongated-oval, yellow-green, 0.8 cm high and 0.3 cm in diameter. The style is filamentous, light blue and it has a central arrangement, 2.085 cm in height and 0.1 cm in diameter (Fig. 2g, h). The style is hollow at the top (Fig. 3d). The stigma has short papillae, concave inwards 0.015 cm long and 0.015 cm in diameter. In the *A. africanus* gynoecium we distinguish the following structural zones: fertile synascidiate structural zone (Fig. 2c), height about 560 µm and fertile symplicate structural zone (Fig. 2d), height of which is about 380 µm and hemisymplicate zone with a height of about 2580 µm (Fig. 2e). There is no asymplicate zone. Septal nectaries appear along the hemisymplicate zone and open with small nectary slits at the base of the style (Fig. 2f). The total height of the septal nectary is 2880 µm (Fig. 3c). The ovary roof is 300 microns (Fig. 1a). The ovary base is 1000 µm (Fig. 1a). In the upper part of the *A. africanus* peduncle and in the ovary wall there are cellular inclusions – raphides (Fig. 6a, b). They are absent at the flower tube base, the free tepals tops, in the stamens, and the style.

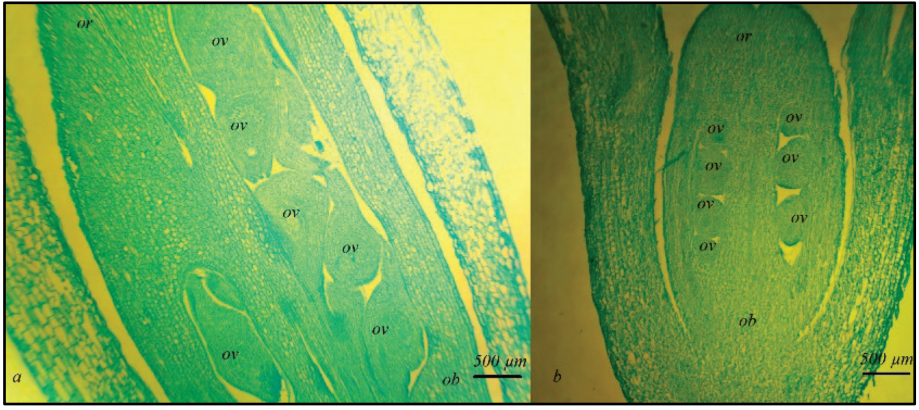

Fig. 1. Longitudinal sections of the ovary of *Agapanthus africanus* (*a*) and *A. praecox* (*b*): *ov* – ovule, *or* – ovary roof

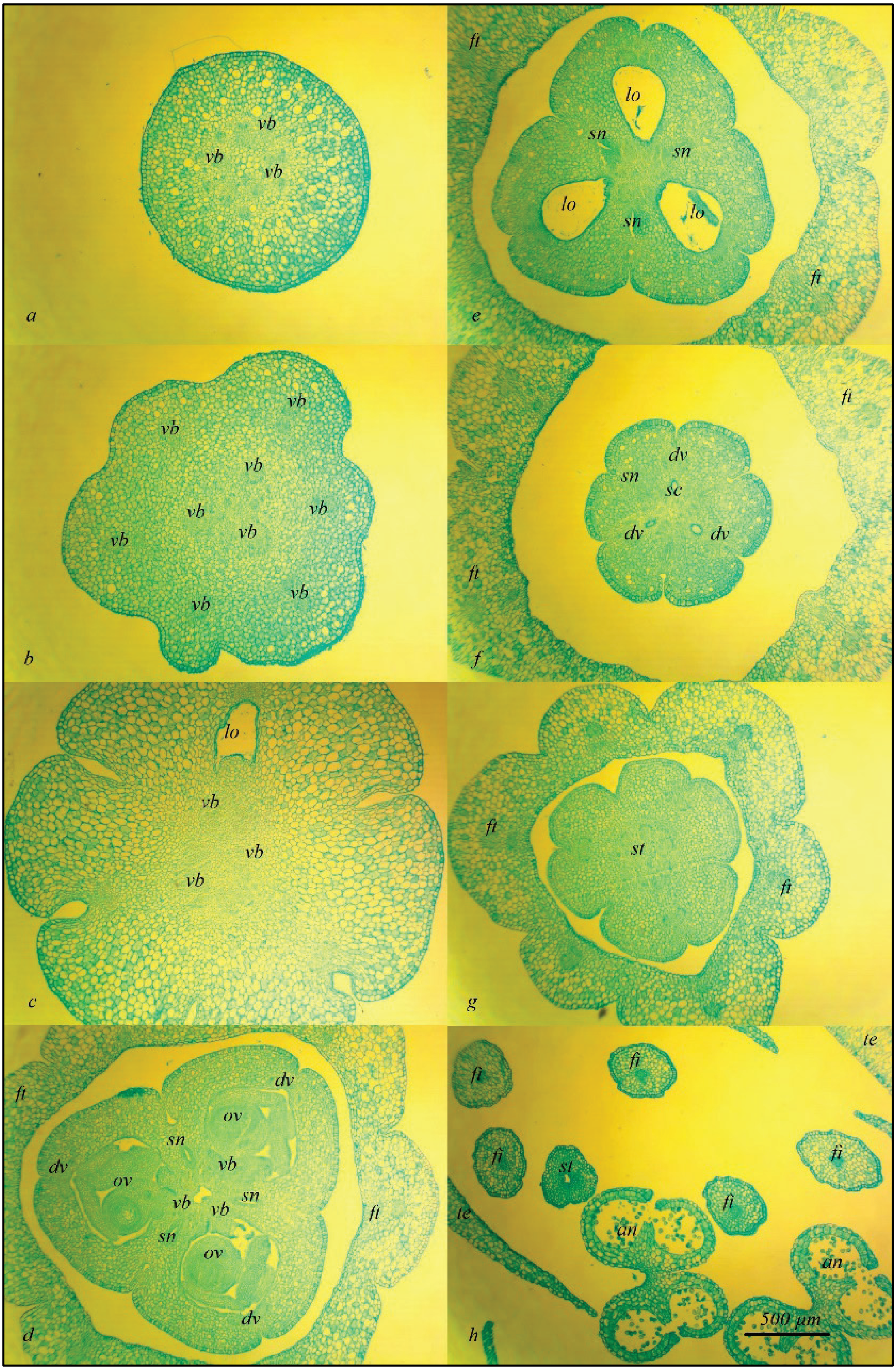

Fig. 2. Ascending series of transversal sections of the flower *Agapanthus africanus*: *a–b* – pedicel; *c* – synascidiate zone, *d–e* – symplicate zone; *f–g* – ovary roof, *h* – free tepals, anthers and style; *an* – anther; *dv* – dorsal vein; *fi* – filament; *ft* – flower tube; *lo* – ovary locule; *ov* – ovule; *sc* – style channel; *sn* – septal nectaries; *st* – style; *te* – tepal; *vb* – vascular bundle

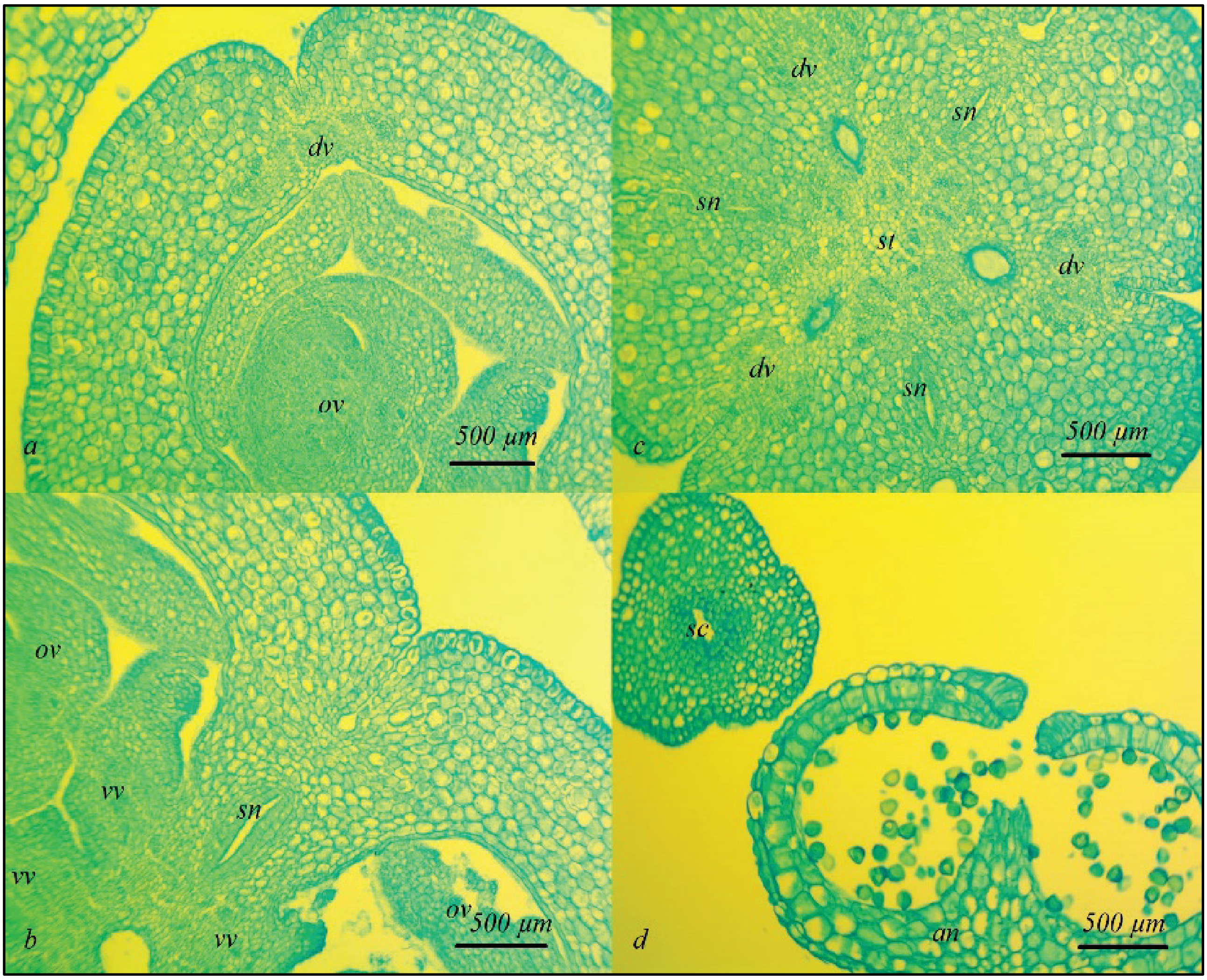

Fig. 3. Floral parts of *Agapanthus africanus*: *a* – ovary wall in the median part of the carpel, dorsal vein composed of three bundles; *b* – ovary wall with septa attached, septal nectary is visible; *c* – central part of the ovary with septal nectaries; *d* – style and anthers, triradial style channel is visible; *an* – anther; *dv* – dorsal vein; *ov* – ovule; *sc* – style channel; *sn* – septal nectaries; *st* – style; *vv* – ventral vein

The vascular system of the *A. africanus* peduncle consists of 10 vascular bundles (Fig. 2a), which above the level of the peduncle give rise to 12 vascular bundles, which are placed in pairs - traces of tepals and traces of stamens (Fig. 2b). In the center there are three massive bundles – dorsal vascular bundles of carpel and small vascular bundles – roots of a ventral complex (Fig. 2c), which above are reorganized into three paired vascular bundles and supplied ovules – ventral bundles of carpel (Fig. 3b). There are are 10–12 ovules in each locule (Fig. 1a), an ovule trace is single-beam. Dorsal vascular bundles are three-bundle (Fig. 3a). Above the locules, the ventral bundles of the carpel merge with the dorsal bundles to form a dorsal vein (Fig. 2f). Traces of outer tepals and inner tepals are single-bundle (Fig. 2h). Stamens traces are single-bundle.

The *A. praecox* flower is up to 3.0–3.2 cm long, white and has a strong aroma. The scape is 92–100 cm long and 0.5–0.7 cm in diameter at the base and 0.4 cm in diameter above. The pedicel is 2.3–2.4 cm long and 0.1 cm in diameter (Fig. 4a, b). The perigonium is six-membered, forms a flower tube 1.1 cm long and 0.4–0.5 cm in diameter (Fig. 2c, d). The outer tepals are 2.2, 2.2, 2.1 cm long and 0.5, 0.6, 0.6 cm wide and inner tepals are 2.3, 2.3, 2.4 cm and a width of 0.9, 0.8, 0.9 cm, respectively (Fig. 4h). The flower tube and tepals in the middle have indented stripes.

Stamens in *A. praecox* are grown to the perianth tube, free at the top. The filaments of the inner circle are fastened 0.5 cm lower than the stamens of the outer circle. The filaments of the outer circle are 2.2–2.3 cm long and 0.85 cm in diameter, and the filaments of the outer circle are 2.4–2.6 cm length and 0.75 cm in diameter (Fig. 4g, h). Anthers are linear, on external and internal stamens anthers are 0.2 cm long and 0.1 cm in diameter and they are attached to the stamen filament below the middle of their height (Fig. 5d). *A. praecox* ovary is superior, three-locular, elongated-oval, green 0.7 cm high and 0.3 cm in diameter with a large number of ovules (Fig. 1b). The white style has a central arrangement 1.875 cm in height and 0.1 cm in diameter and style channels appear above the locule (Fig. 4h). The stigma have papillae 0.025 cm long and 0.02 cm in diameter.

A. praecox gynoecium has the following structural zones: fertile synascidiate structural zone (Fig. 4d), height about 200 μm and fertile symplicate structural zone, height of which is about 600 μm (Fig. 4e) and hemisymplicate zone with a height of about 620 μm (Fig. 4f). There is no asymplicate zone. Septal nectaries appear along the hemisymplicate zone and open with nectary slits at the style base (Fig. 4g, h). The total height of the septal nectary is 820 μm (Fig. 5c). The ovary roof is 200 microns (Fig. 1b). The ovary base is 600 μm (Fig. 1b).

In the upper part of the *A. praecox* peduncle and in the ovary wall there are cellular inclusions – raphides (Fig. 6c, d). They are absent at the flower tube base, the free tepals tops, in the stamens, and the style.

The peduncle in *A. praecox* contains 8 vascular bundles (Fig. 4a), which branch above and at the level of receptacle depart 6 pairs of vascular bundles – traces of tepals and traces of stamen (Fig. 4b) s, and above traces of dorsal vascular carpel bundles (Fig. 5a).

In the center there are three massive vascular bundles – roots of a ventral complex (Fig. 5b). Above, they are transformed into paired vascular bundles – ventral bundles of the carpel (Fig. 5c). There are 6–8 ovules in each locule, the trace of the ovule is single-bundle. Dorsal vascular bundles are single-bundle (Fig. 5a). Above the ovary locule, the ventral bundles of the carpel end blindly and do not merge with the dorsal bundles. Traces of outer tepals and inner tepals are single-bundle (Fig. 5d). Stamens traces are single-bundle.

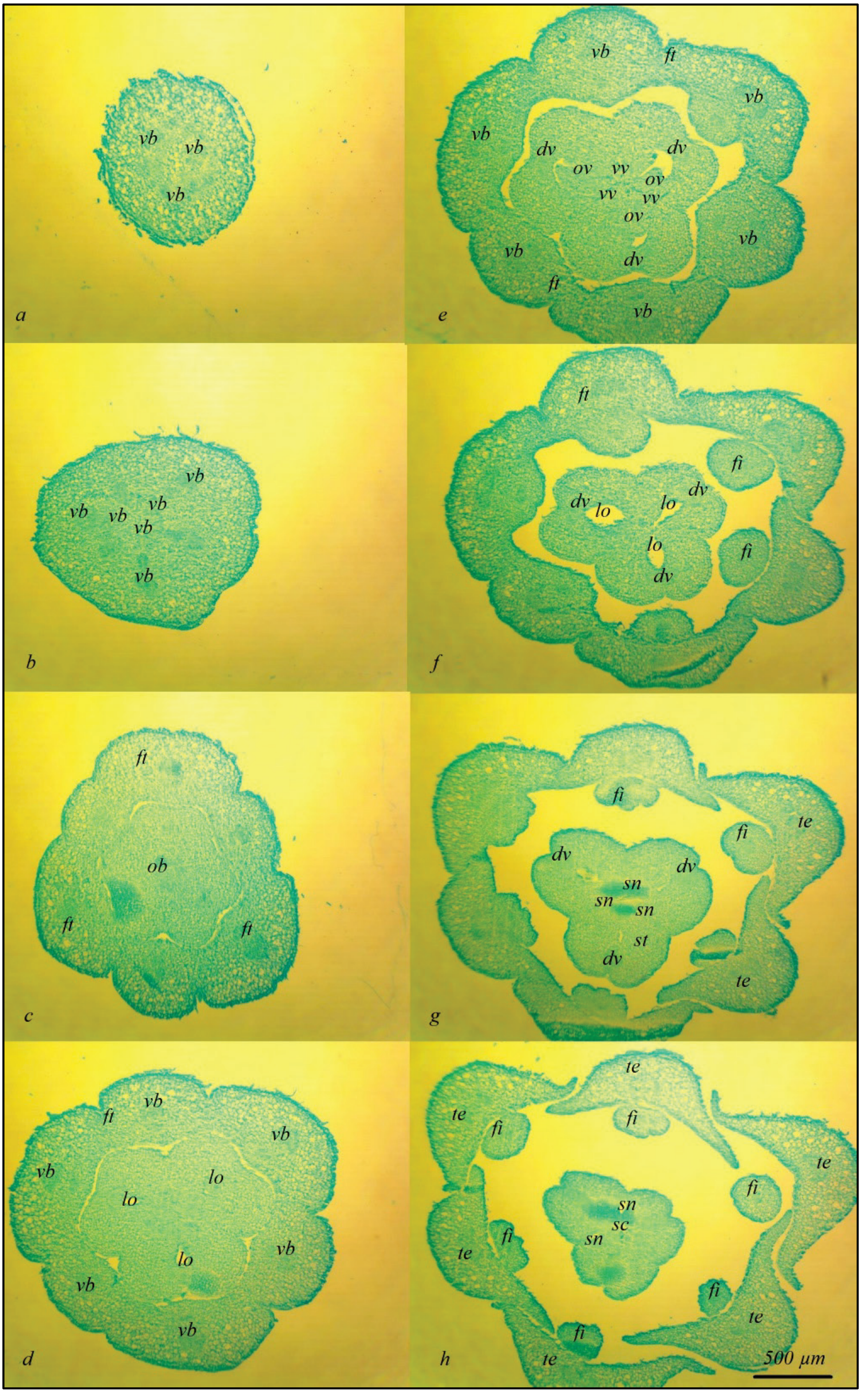

Fig. 4. Ascending series of transversal sections of the flower *Agapanthus praecox*: *a*–*b* – pedicel; *c* – inferior ovary base; *d* – synascidiate zone; *e*–*f* – symplicate zone; *g* – hemisymplicate zone; *h* – ovary roof; *dv* – dorsal vein; *fi* – filament; *ft* – flower tube; *lo* – ovary locule; *ov* – ovule; *sc* – style channel; *sn* – septal nectaries; *te* – tepal; *vb* – vascular bundle; *vv* – ventral vein

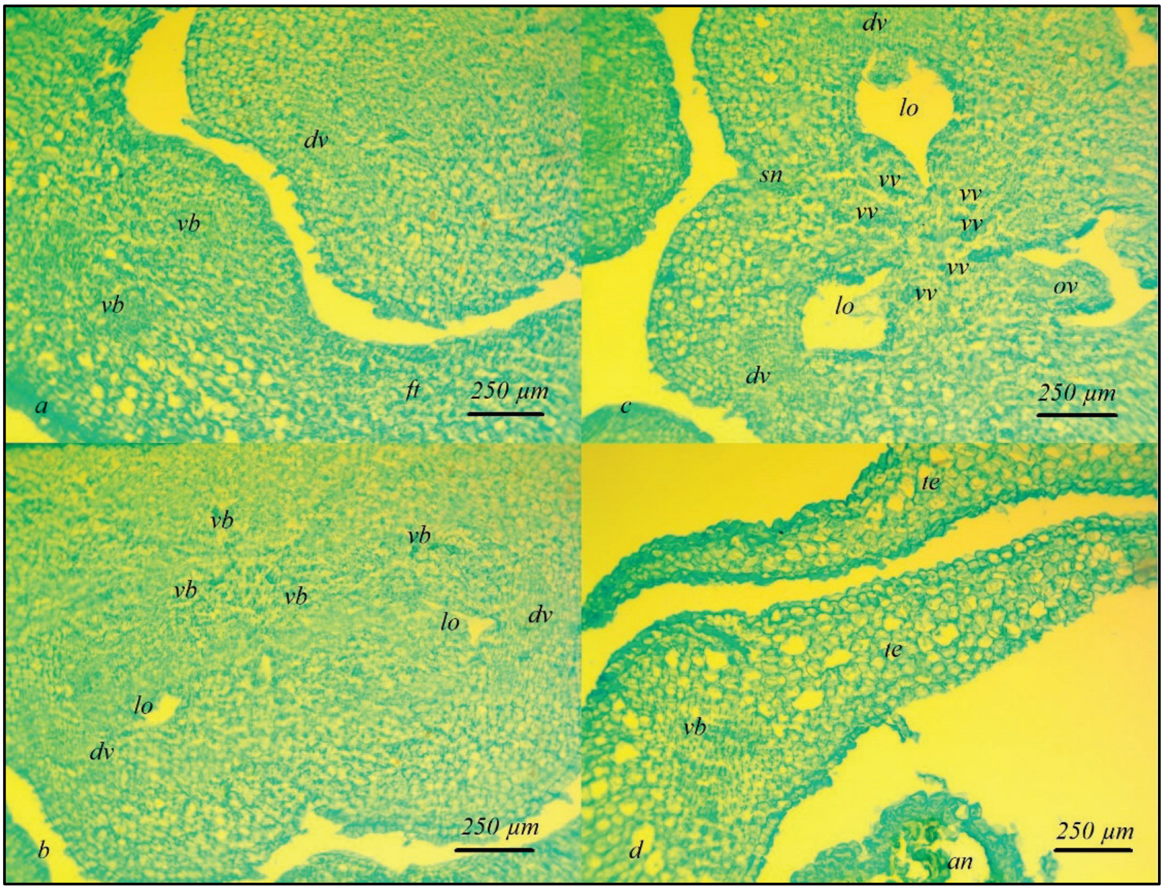

Fig. 5. Floral parts of *Agapanthus praecox*: *a* – ovary wall in the median part of the carpel, dorsal vein and flower tube are visible; *b* – central part of the ovary, ovary base with locules is visible; *c* – central part of the ovary with septal nectaries; *d* – anther and tepals are visible; *an* – anther; *dv* – dorsal vein; *ov* – ovule; *sn* – septal nectaries; *te* – tepal; *vb* – vascular bundle; *vv* – ventral vein

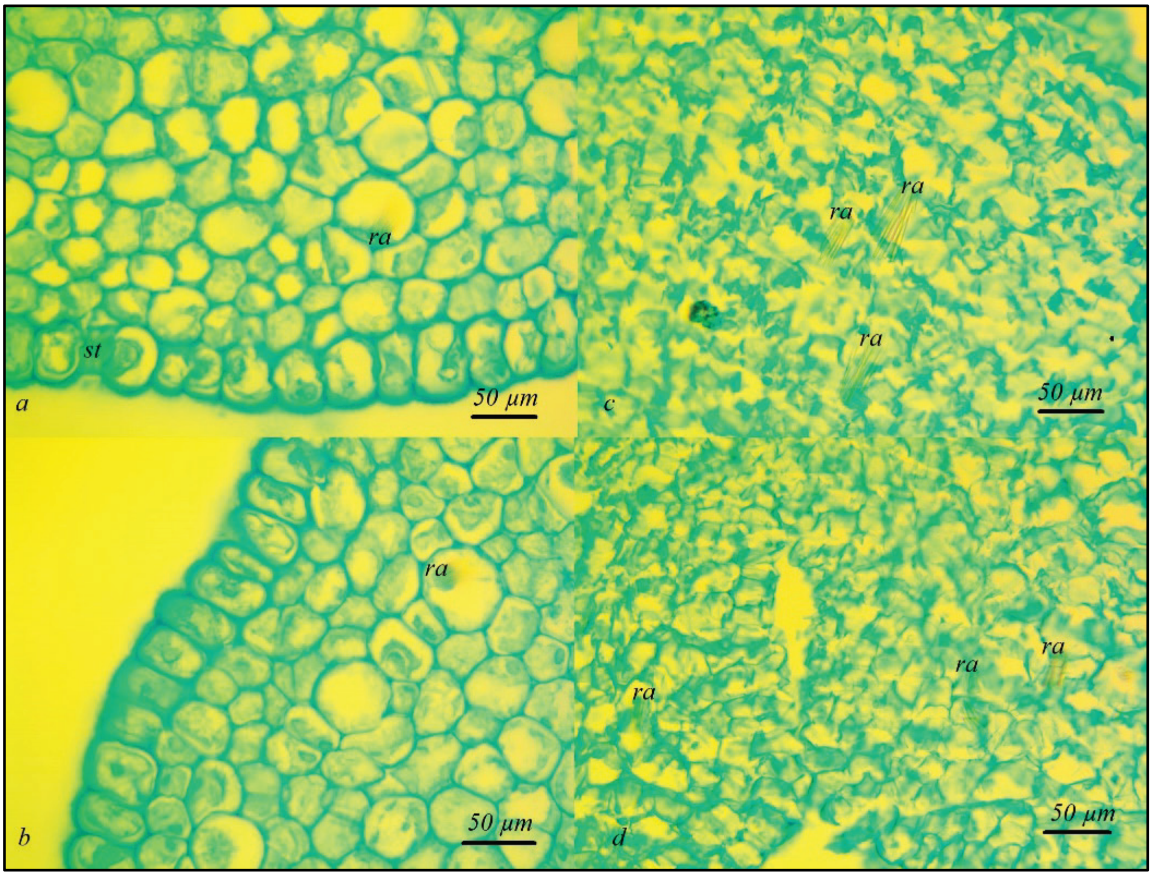

Fig. 6. Raphides and stomata in the distal parenchyma of the ovary wall of *Agapanthus africanus* (*a*, *b*) and *A. praecox* (*c*, *d*): *ra* – raphides; *st* – stomata

Discussion

Flowers in the genus *Agapanthus* are trimerous, hypogynous and zygomorphic. There are 6 tepals, basally fused, outer tepals are narrower than inner, thickened. There are 6 stamens, inserted on the tube. Filaments in genus *Agapanthus* are declinate, anthers are dorsifixed, introrse with longitudinal dehiscence. The ovary is always superior, ovoid and trilocular. Also in the ovary inner septal nectaries are present, there are many ovules in the ovary. The style is straight and hollow, stigma is very small. The peculiarity of the fruit is a loculicidal capsule which contains a lot of winged and black seeds (Meerow & Snijman, 1998).

The ovary is superior in members of the genus *Agapanthus*. These plants are rhizomatous, roots are fleshy, provided with a multiple velamen. Vessels are only in roots, mostly with scalariform perforations. Calcium oxalate raphides are present. Leaves are rosulate, distichous, linear, sheathing at base. The flowers are in a pseudo-umbel subtended by two involucral spatial bracts, zygomorphic, pedicels subtended by threadlike bracts. Tepals are subequal, basally more or less connate. The stamens are inserted on the perianth tube; filaments are declinate, of unequal length; anthers are dorsifixed. Pollen grains are 1-colpate, reticulate. The style is slender, hollow, declinate, with punctiform stigma; ovary 3-locular, with inner septal nectaries. The ovules are numerous, campylotropous, crassinucellate. The parietal cell is present. The fruits are loculicidal capsules. The seeds are black, angulate, elongated, winged (Takhtajan, 2009).

According to Daumann (1970), the genus *Agapanthus* has an internal septal septal nectary. In general, the family Amaryllidaceae is characterized by the presence of septal nectaries (Daumann, 1970; Meerow & Snijman, 1998; Takhtajan, 2009).

Most of the studied monocotyledonous nectaries have an extremely thin cuticle, only about 17% of the examined genera with septal nectar have no cuticle at the sites of nectary secretion, namely *Hosta*, *Agapanthus*, *Allium*. Discharge in the form of a liquid wedge passes through the sometimes more or less mucous outer walls of the epidermis and through the cuticle, without lifting or rupture during the process. There are no places on the surface of the nectary that seem best for the nectary. Isolation without the cuticle occurs in *Hosta*, *Hemerocallis*, *Kniphofia*, *Agapanthus*. The cuticle in the nectaries is absent in several cases, and only in septal nectaries in *Hosta*, *Hemerocallis*, *Phormium*, *Kniphofia*, *Agapanthus*, *Allium*, *Sansevieria*.

The septal nectary of *A. umbellatus* regularly contains nectar, which produces the inner septal nectary and reaches the outer groove of the septum through three discharge points at the apex of the ovary. Thus, there is only one inner septal nectary, which lines the direct septal fissures contained in the ovary from the ovary base to the ovary roof almost the entire length (i.e. except the uppermost part before the exit point), a three-layer parenchyma nectary is described in *A. umbellatus* (Daumann, 1970).

Changes in fresh weight, peroxidase activity, soluble protein and anthocyanin content and changes in membrane permeability at four different stages of flowering (flower bud development, anthesis, mature flowers, senescing flowers) were found in *A. africanus*. It was found that the amount of fresh weight in the stage of mature flowers is the highest when it was compared with aging flowers. There is a negative correlation between a decrease in anthocyanin content and an increase in membrane permeability in flower senescing due to the loss of semi-permeability in the membranes during senescing flowers (Gören Sağlam, 2010).

A. umbellatus L'Her is the diploid plant and no abnormality in pollen mother cells were observed. The percentage of pollen germination was 12.5–32.7%. This number may be seen too small because the observation was made only one hour after pollination, and so the real number of pollen capable of germination would be higher. Two methods of pollination were used, one was cross-pollination and the other was open pollination. The results were somewhat better in the case of open pollination, namely 258 flowers were pollinated and 33 capsules were fructified, the percentage of fructified capsules for pollinated flowers were 12.8%. In the case of cross-pollination 31 flowers were pollinated but no capsule was fructified. The seed of *A. umbellatus* L'Her has a crater on one side and shape of capsule is a long ellipse with high three mounds. Three kinds of seed were recognized in the capsule. The cause of high sterility in *A. umbellatus* L'Her could not be a recognized cytological relation but seemed to be in high relation with the equilibrium of nutriment between sexual organ and nutritive organ. The remarkable vegetative development of the nutritive organ was considered to have important correlation with the fruit-bearing. (Suge, 1952).

Micro- and megasporogenesis, as well as male and female gametogenesis of the genus *Agapanthus*, were first reported by Zhang et al. (2010). The anther wall, the development of which has a dicotyledonous type, consists of four layers: the epidermis, endothecium, one or two middle layers and the secretory tapetum. Fibrous thickenings develop in the endothecium during shedding. Sequential cytokinesis during microsporogenesis leads to a decussate tetrad of microspores. Ellipsoid pollen grains are 2-celled when the anthers disintegrate, with a mononucleate extending to the polar region. The ovary is superior and trilocular, with an axial placenta. The ovules are anatropic, and tenuinucellate. The archesporial cell under the epidermis of the nucellus functions directly as a megasporocyte (Zhang et al., 2010).

To understand the molecular mechanisms of flower initiation in *A. praecox* ssp. *orientalis* comprehensive transcriptomic and proteomic analyzes were made. Samples of stem tops were collected at three different points in time, including vegetative, induced, and reproductive periods. A large number of genes and proteins were regulated during the induced and reproductive stages. Their expression profiles demonstrate that carbohydrate metabolism provides the basis for floral initiation in *Agapanthus* (Zhang et al., 2013).

New features of the anatomical structure of the flower *A. africanus* and *A. praecox*, which we found, are the presence of three-bundle dorsal carpel bundles in *A. africanus* and single-bundle in *A. praecox*, the presence of a ventral complex that is reorganized into paired ventral vascular bundle, the presence of a high ovary base and the ovary roof, the presence of synascidiate, symplicate and a hemisymplicate gynoecium structural zones. Also, the height of the ovary zones in the studied species and the length of septal nectaries are very different.

Conclusion

The new data help deepen the knowledge about the micromorphological and anatomical features of the *A. africanus* and *A. praecox* flowers, in particular, the anatomical structure of tepals, gynoecium vertical zonality and vasculature of the flower as a whole were studied. The ovary revealed features of the early stages of fetal morphogenesis, as evidenced by triple dorsal bundles of carpels and long septal nectaries. Since the ovary is a structural basis of the fruit, histological ovary wall differentiation displays the specifics of further morphogenesis of the fruit. Septal nectaries in the *A. africanus* and *A. praecox* flowers occupy two-thirds of the length of the ovary and open at the base of the style. Nectary tissue surrounds the septal nectary slit, except for the bundles. All cells are located perpendicular to the surface of the nectary in the form of a fence, they are about 2–8 times longer than wider, often with more or less protruding outer walls, sometimes secondarily separated by transverse walls. The features of micromorphology and vascular anatomy obtained during the study will be further used in the taxonomy by morphological features for the family Amaryllidaceae.

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