

The Morphological and Anatomical Structure of Seeds of *Allium Stipitatum* Regel and *Allium Giganteum* Regel (Amarillidaceae)

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Abstract: For the first time, the structure of the seeds of *Allium stipitatum* (Persian shallot) and *Allium giganteum* (giant onion) from Tashkent Botanical Garden was studied, and the following diagnostic features of this species were described: the seeds consist of external and internal integuments and endosperm; the outer integument has a melanin in its content and forms a powerful melanin crust; the outer integument protects the underneath cellular structure called parenchyma; inner integument serves as a good cuticle; large nuclei occur in the endosperm. The embryo is cylindrical and equal to the endosperm. Cotyledon is large and forms the bulk of the embryo mass. Research results show the adaptation capacity of the studied features to the habitat conditions.

Keywords: anatomy, seed, introduction, *Allium giganteum*, *A. stipitatum*.

1. Introduction

The *Allium* L. is a polymorphic genus which includes more than 800-900 species (Fritsch R.M., Blattner F.R., Gurushidze M., 2010). There is no common opinion about its taxonomy and phylogeny and no modern monograph of the genus. During recent years taxonomists gave much attention to anatomical and serological studies of the species to resolve some controversial issues (Cheremushkina V.A., 2004). From this point of view, the study of the structure of the seeds is important. Onions are represented by medicinal, decorative and food species. Among food species, the *A. cepa* L. (common onion) is the most well-known with its useful properties. Its bulbs contain an essential oil (up to 0.05%), sugars (10-11%), including glucose, fructose, sucrose and maltose, inulin, phytin, nitrogenous substances (up to 2.5%) vitamins C (10 mg %), B₁ (60 mg %), provitamin A (carotene), flavonoids, quercetin or its glycosides. In its leaves there are reducing sugars (up to 2%), vitamins C (20 mg %), B₂ (50 mg %), provitamin A (4 mg %), citric and malic acids, and essential oil. In folk medicine, onions have been used for medical purposes as diuretics. In a baked form it is applied externally for treating certain skin diseases and uterine bleeding. Bunching onion, long green onion, Japanese bunching onion (*A. fistulosum* L.) are widely used in Chinese traditional medicine as hemostatic, for the treatment of patients with hypertension, atherosclerosis, rheumatism, and as antihelminthic and bactericidal agent in gastrointestinal diseases, accompanied by the processes of putrefaction and fermentation, for cancer prevention, externally – for the treatment of gout, pyoderma and other skin diseases (Ibragimov F.I., Ibragimova V.S., 1960). Some species of *Allium* (*A. giganteum* and *A. stipitatum*) are decorative, and also are the subjects for intensive study. Adaptability is a complex and multifaceted phenomenon which is determined by phylogenetic adaptation of the structural complex of the seeds correlated with such ecological parameters as type of plant community, climatic and geographic characteristics of the environment, because adaptability of seeds is phylogenetic feature, but not ontogenetic. "The seeds are that part of the plant that lies

between "generative organs" and "vegetative organs", as traditionally stands for two spheres of plants. The seed is a formation which is less ephemeral than a flower. Dropped off the plant, it leads a long existence mainly in such aggressive environment as soil, where the seeds need to survive to be able to fulfill their destiny - to germinate (Oganezova G.G., 2008.).

2. Study area and data analysis

The object of study is perennial monocotyledon plants - *Allium stipitatum* Regel and *Allium giganteum* Regel (Amarillidaceae). The raw material was collected from collection of rare, endemic, and introduced plants of the laboratory of «Introduction of woody plants» of the Tashkent Botanical Garden.

The seeds were fixed in 70% ethanol and softening solutions – ethanol, glycerin, distilled water (1:1:1) for further anatomical study. Transverse sections of the seeds were conducted serially. The preparations were stained with methylene blue followed by sealing with glycerin-gelatin (Barykina R.P., Veselova T.D., Devyatov A.G. et al., 2004). Photomicrographs are made with a computer micro photoset with a digital camera Samsung ES70 and microscope of Motic B1-220A-3.

3. Results and Discussion

A. stipitatum and *A. giganteum* are perennial, monocot plants from the section *Molium*. They are decorative plants and from this point they were attractive for this study. Fruit shape of *A. stipitatum* is a flattened globular box. Cross section of the seeds of *A. stipitatum* are rounded and slightly crested with well differentiated radicles, rudiments of the cotyledon leaf, and well developed endosperm with prominent nuclei. The cells of the endosperm are elongated, comparatively friable and have pores located along in the centripetal direction (Fig. 1).

The number of the ovules in each nest is 2, in total 6, arranged in 2 rows, anamythrophic, bicuspid, tenuinocellate. The representatives of the genus *Allium* have characteristic well-developed large funicular obturators occurred in the micropilar region of the ovule. They locate for long time after germination and are considered as arils (Komar G.A., 1985). The seeds are comprised from the external and internal integuments of the testa, endosperm and embryo. The external integument is composed of the parenchymal cells. They are sinuous, large and small, of different shapes. The parenchyma cells of the intercostal areas are flattened and arranged in 1 - 2 rows; rib regions are composed with 2 - 4 rows of the cells. Testa of the seed is formed, mainly, due to external integument. Exotesta is its protective layer, its

cells are with thickened shells and convex, sinuous, comb-like outer walls filled with inclusions of melanin forming stronger melanin crust. The inner integument is located above endosperm, its cells are relatively large, isodiametric, elongated, cubic, of different shapes, mostly with different thickened porous membranes containing protein. The walls of the cells are relatively thickened. The nuclei of the endosperm cells are large. The embryo is small, cylindric, curved and almost equal to the endosperm with its length. Spare fats are observed in embryo cells (Fig. 1).

The cotyledon is not large and represents only a small part of the embryo, the radicle and small plumula occupy a smaller part of it (Fig. 1).

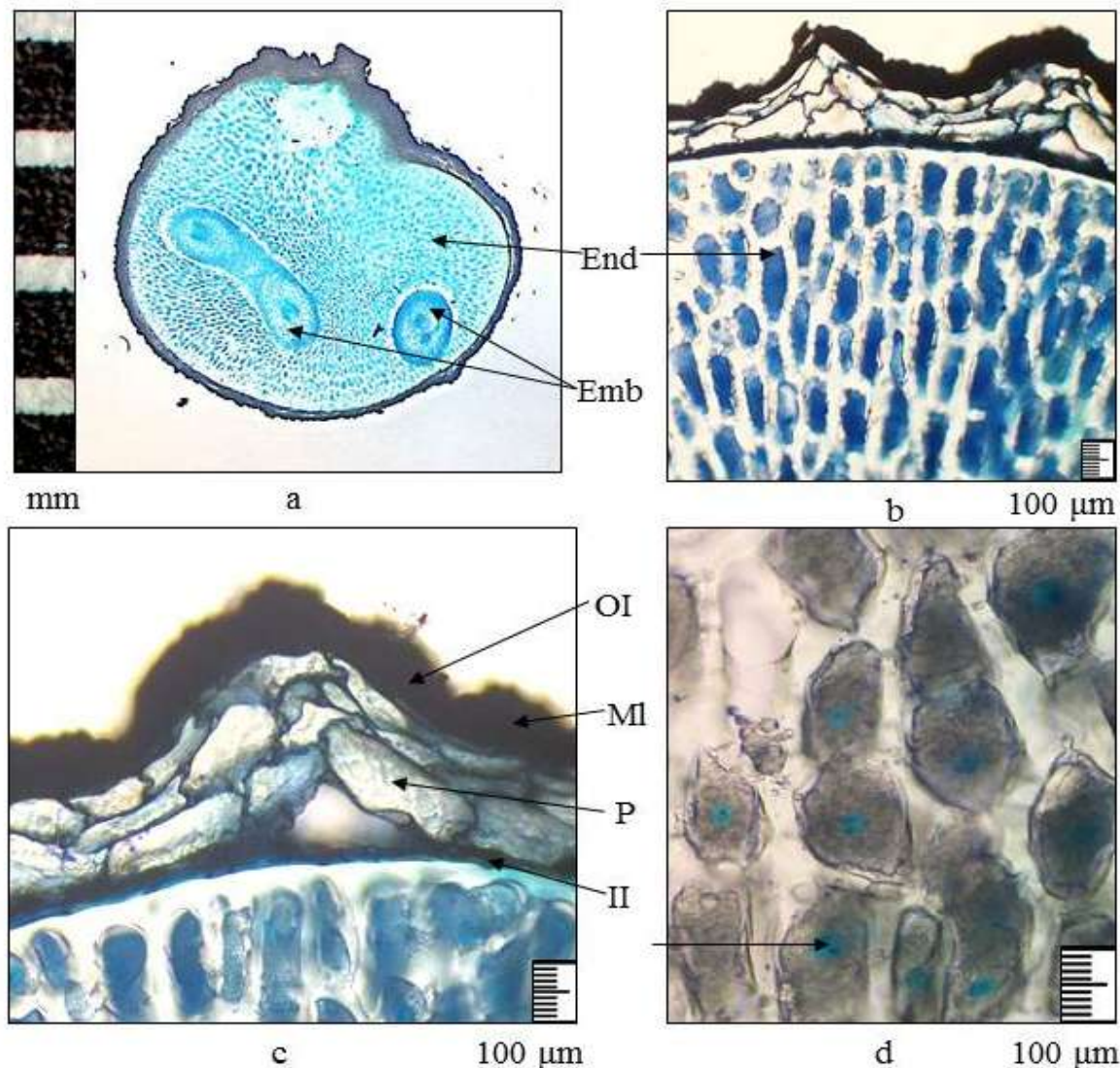


Figure 1: Structure of the seed of *Allium stipitatum*: a – general view of seeds; b - detail; c - outer and inner integuments, d-- scallops of the seed; e - endosperm

Legend: II - inner integument, Emb - embryo, MI– melanin, OI - outer integument, End – endosperm

The fruit of *A. giganteum* is a triangular box, almost spherical. The seeds are also trihedral, angular, compressed laterally, flat-convex, almost flat, black with a wrinkled surface, matte. The cross section of the seeds of *A. giganteum* are ribbed and combed. Differentiated radicle, rudiments of

the cotyledon leaf and well-developed endosperm with well-defined large nuclei are well observed in the seeds of *A. giganteum*. The endosperm cells are well developed and located along the centripetal direction (Fig. 2).

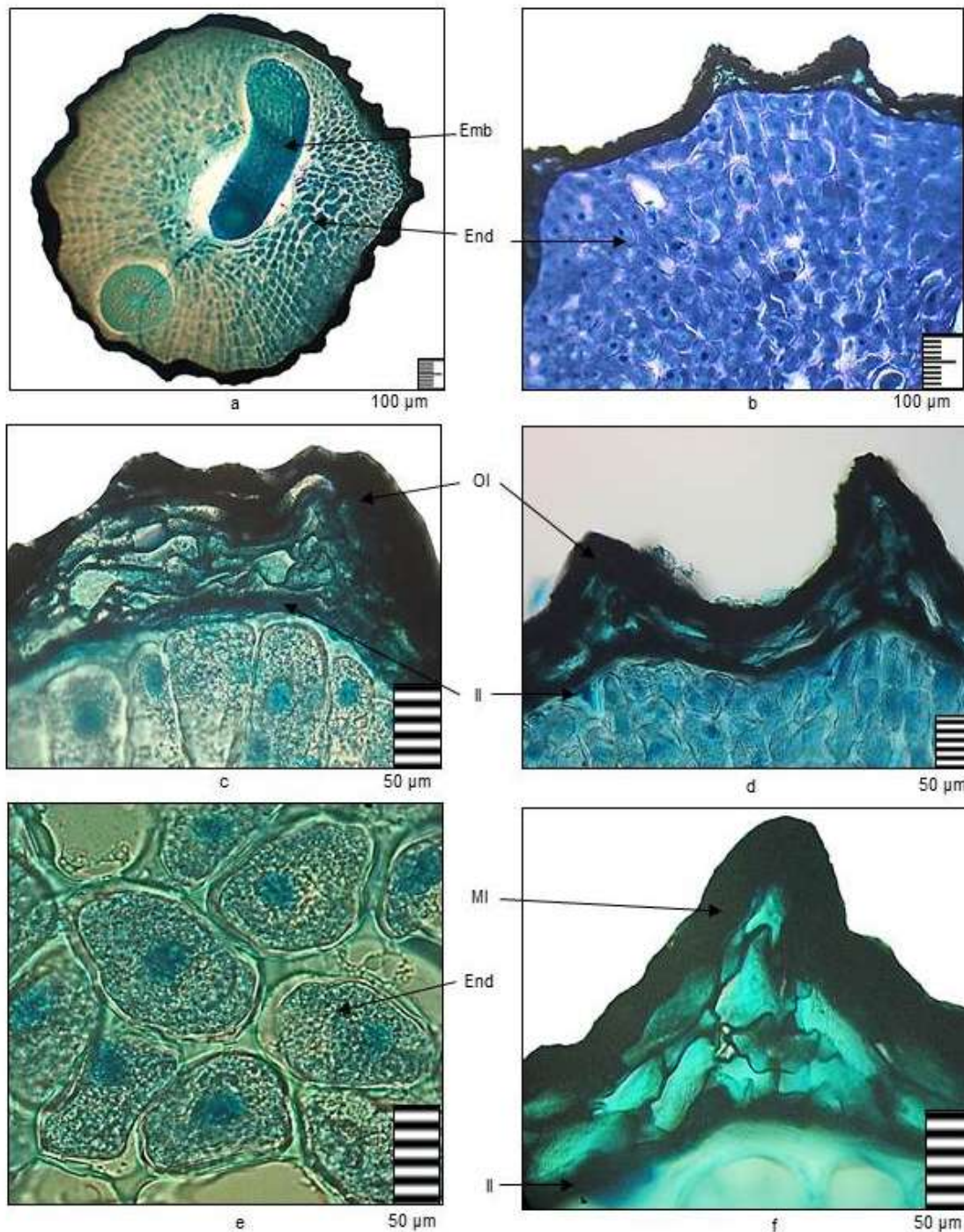


Figure 2: Structure of the seed of *Allium giganteum*: a – general view of seeds; b - detail; c-d-f - scallops of the seed; e - endosperm.

Legend: II - inner integument, Emb - embryo, MI– melanin, OI - outer integument, End – endosperm

The ovules in each nest of 2 in total 6 ovule are arranged in the 2 rows, anamythrophic, biparic, tenuinocellate. For ovules of the plants of *Allium*, a well-developed large funicular obturator, which covers the micropilar region of the ovule, is characteristic.

Seed skin consists of external and internal integuments, and endosperm. The external integument is composed of the parenchymal cells. They are sinuous, large and small The parenchyma cells of the intercostal areas are flattened and arranged in 1-2 rows; rib regions are composed with 2-5

rows of the cells. Testa of the seed is formed, mainly, due to external integument. Exotesta is its protective layer, its cells are with thickened shells and convex, sinuous, comb-like outer walls filled with inclusions of melanin forming stronger melanin crust.

The inner integument is located above endosperm, its cells are relatively large, elongated, of different sizes, with dense, less thickened porous membranes containing protein. The nucleus of endosperm is large (Fig. 2).

The embryo is small, cylindrical, curved and almost equal in length to the endosperm. Spare fats are observed in the cells of the embryo. Cotyledon is large and comprises considerable part of the embryo, the radicle and small plumula occupy a smaller part of it (Fig. 2).

The two reviewed species, *A. stipitatum* and *A. giganteum*, are similar with anatomical structure of the seed, but differ with the following features: the shape and the size of the seeds, endospermal cells, density of the location of endospermal cells, and the size of the embryo; by the number of pores between the cells, thickness of the melanin crust and parenchymal cells.

4. Conclusions

Thus, the study of the structure of the seeds of *A. stipitatum* and *A. giganteum* in the conditions of their introduction suggested the following diagnostic features of this species: the seeds consist of external and internal integuments, and endosperm. The external wall of the integument includes melanin and forms a powerful melanin crust; the external integument preserves the cellular structure - the parenchyma; inner integument - good cuticle; the endosperm is clearly expressed with relatively large nuclei. The embryo is cylindrical almost equal in length to the endosperm. The cotyledon is large and constitutes the bulk of the embryo. The revealed signs show the adaptation of the studied species to the habitat conditions.

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