SURFACE OF INTRAFLORAL NECTARY IN 'BESZTERCEI' PLUM CLONES

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Abstract

The intrafloral nectary of 'Besztecei' plum clones is covered with cuticle. The cuticle covering the epidermis is usually striate, but rarely it can be smooth, as well. The cuticle ridges around the stomata are often radially oriented and on the interstomatal epidermal cells they are broken at the cell borders. They may occur at smaller or greater intervals, they can be either straight or twisted. Similarly to other Prunoideae taxa, the gland epidermis consists of polygonal epidermal cells, stomata and trichomes. The outer tangencial wall of the epidermal cells is often bulging like a papilla. The stomata are able to function, and concerning their position related to the epidermal cells, they can either be at the same level, or more or less sunken, or sometimes rising above the epidermal cells. Within a single flower two ecological types may occur. The majority of the clones can be classified into the mesomorphic type. The trichomes are uni- or multicellular, short and thick or long and thin, and they prevent nectar flowing out of the flower.

Key words: plum, nectary, floral biology, epidermis

Introduction

The characteristics of the plant epidermis usually indicate the correspondance of the taxon with environmental conditions. It is known that among plant organs the flower is the most constant one, which changes the least with environmental

conditions. In the life of a plant the blooming period is relatively short, generally lasting only for a few days, while the leaf might be exposed to environmental effects for a long time. Among the parts of a flower, after the calyx, the nectary epidermis is the most similar to leaf epidermis, since according to Fahn's (1979) summary, it is covered by cuticle, broken up by stomata and at certain taxa it also has trichomes.

Studying nectary epidermis is necessary partly concerning ecotype and partly for flower biological research. Knowing the ecotype, plantation can be planned better. It is also important to know the epidermis structure from the point of view of flower- and pollination biolgy, since the gland surface may influence nectar keeping by its outstanding ribs or ridges, and consequently it has an effect on the the durability of insect attraction (Orosz-Kovács, 1990).

Fahn (1979) states about nectary epidermis that epidermal cells can be cubical or palisad-like. He classifies nectaries, and distinguishes a type that exudates nectary through stomata. Rosaceae taxa belong to this type.

The stomata are generally modified, the guard cells have usually lost the ability to close the stomatal aperture (Fahn, 1979; Gulyás, 1991), but in Rosaceae taxa the active functioning of stomata is quite common, which results in the periodicity of nectar secretion (Orosz-Kovács, 1990, 1991, 1993). The flower often becomes empty as a consequence of this rhytmicity, and the insect attraction of the flower ceases in the pauses of secretion. These phenomena underline the importance of the gland surface being smooth or broken up by ribs, which influences the length of time, while the secretory product remains in the flower.

According to Gulyás, 1991, the nectary epidermis is one layer thick, with closely attached cells of various shapes. According to him, the type of nectar secretion is determined by the structure of the epidermis.

According to Kartashova, 1965, the stucture of the nectary epidermis within the flower is the function of the position of the gland. The glandular epidermis protected by a tubular corolla is higromorphic, while flowers exposed to outer effects have mezo-or xeromorphic types. Our previous studies on Prunoideae taxa allow the conclusion (Orosz-Kovács et al., 1990; Orosz-Kovács, 1993) that the position of the stomata in the glandular epidermis is not merely the function of a gamopetalous or free corolla. Examining several cultivars of a single species, significant differences could be observed in the case of cherry (Orosz-Kovács, 1991, 1993; Orosz-Kovács and Apostol, 1993), sour cherry (Orosz-Kovács, 1990, 1991, 1993; Orosz-Kovács et al., 1993), and plum (Orosz-Kovács et al., 1990–91), although the structure of the flower was the same at each cultivar, namely the receptacle was a hypanthium sunken like a cup. It suggests that the laxial, protected surface of the hypanthium is suitable for determining the otype of the taxa.

Among other Rosaceae taxa we studied the nectary surface of apple more carefully, and we observed that the ornamentation of the cuticle differs strikingly from that of Prunoideae taxa (OROSZ-KOVÁCS et al., 1990): it can be characterised by folded laminae rather than striae.

Literature on cuticle ornamentation was summarized by METCALFE and CHALK and they also established a classification in 1979, also used by us.

About the cuticle covering nectary epidermis and its ornamentation in taxa not belonging to Rosaceae, data can be found in the works of FAHN (1979) and DURKEE (1983). Concerning the nectary epidermis of other Rosaceae species, few descriptions are known except for the studies of KARTASHOVA, 1965 and GULYÁS, 1991. In our previous works we reported on the nectary surface of Prunoideae taxa, dealing with more fruit species and several cultivars of these (OROSZ-KOVÁCS et al., 1990, 1990–1991, 1993).

Connection could be observed between nectary surface and fruit yield in the case of cherry cultivars, where cultivars with a xeromporphic nectary epidermis yielded more fruit, while those with the higromorphic type usually dropped their fruit in the slightly drier environment of Hungary (OROSZ-KOVÁCS and APOSTOL, 1993).

The cuticle ornamentation of the nectary surface in some plum cultivars was presented in one of our previous works (OROSZ-KOVÁCS et al., 1990–91), according to which the ornamentation of the cuticle is characteristic for varieties or variety-groups. Structure of primary cuticle is basically of two types: striate and reticulate. Striate form is extremely common, this is characteristic to most varieties. Between the two basic types, there are intermediate forms. Cuticular striae are radially ordinated around the stomata of the nectary epidermis covering the gland. Thin sulci acting as microcapillaries distribute the secreted nectar throughout the whole surface and retain it at the same time. Thick, striated cuticle has a good nectar retaining effect, while thin reticulum is less effective. Consequently, the former structure is more attractive for insects than the latter one. The careful examination of the nectary epidermis in Besztercei plum clones has not occured yet. Concerning the size of the nectary, however, we presented some articles previously (RÓKA and OROSZ-KOVÁCS, 1994; RÓKA et al., 1997), in which an apicultural scale of value was established based on the size of the gland. Connection between nectary structure and flower structure in plum varieties was dealt with in the work of (SURÁNYI and OROSZ-KOVÁCS, 1992). Flower morphological studies in clones of cultivated plum varieties were carried out by (SURÁNYI, 1983), who also studied the importance of the cultivar, the rootstock and the environment in plum production development (SURÁNYI, 1991), pollen viability and free of 'Besztercei' plum clones of Hungarian and foreign origin (SURÁNYI, 1996), as well as virus-sensitivity (SURÁNYI and ERDŐS, 1992).

Material and Method

The studied flowers of five 'Besztercei' plum clones originated from the basic collection of the Experimental Station of the Fruit and Ornamental Plant Production and Development Corporation in Cegléd. The living material collected for investigation was fixed in 0,2 mol glutareldehide, and washed in 0,1 mol Na-cacodilate-buffer, then dehydrated in ethylene-series. After drying on the critical point, the material was prepared for SEM-study, SEM-micrografs were executed by an SID-4 SEM adapted to a Yeol 100 C equipment. The position of stomata was studied in medial longitudinal sections of the flower. Sections were prepared by microtome after embedding in paraffine, in 5–10 μm thickness. Staining was carried out with toluidine blue.

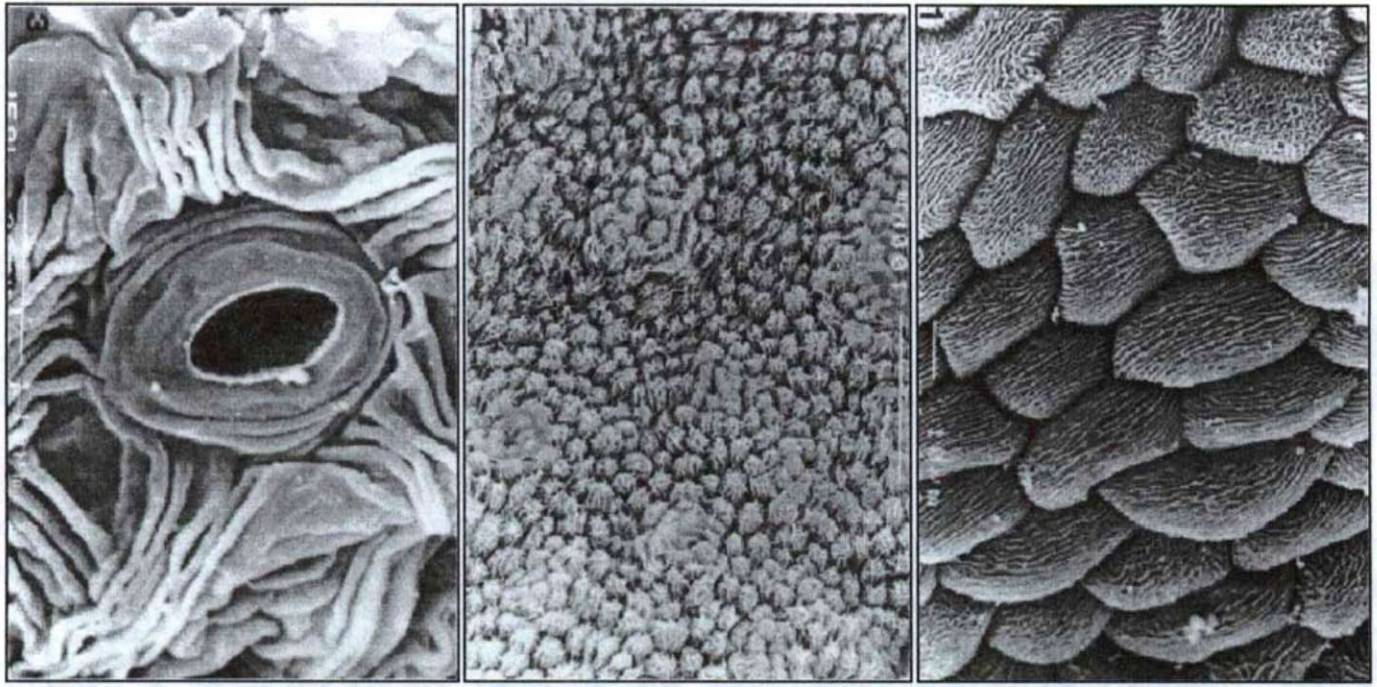
Results

Similarly to other plants and Prunoideae taxa, the nectary surface of 'Besztercei' plum clones is covered by cuticle (Orosz-Kovács et al., 1990). The surface of the nectary may change within a single variety, depending on being studied at the base or at the apex of the gland. At the Besztercei 142–59 variety the cuticular ribs of the epidermal cells at the basis of the gland are thinly scattered, evenly distributed, running parallelly, forming no ridges secondarily turned up (Fig. 1). At the apex of the gland the ribs are more frequent and their distribution is irregular. The ribs become wavy and twisted because of having turned up secondarily, and they often form ridges at the tip of the epidermal cells bulging like a papilla (Fig. 2).

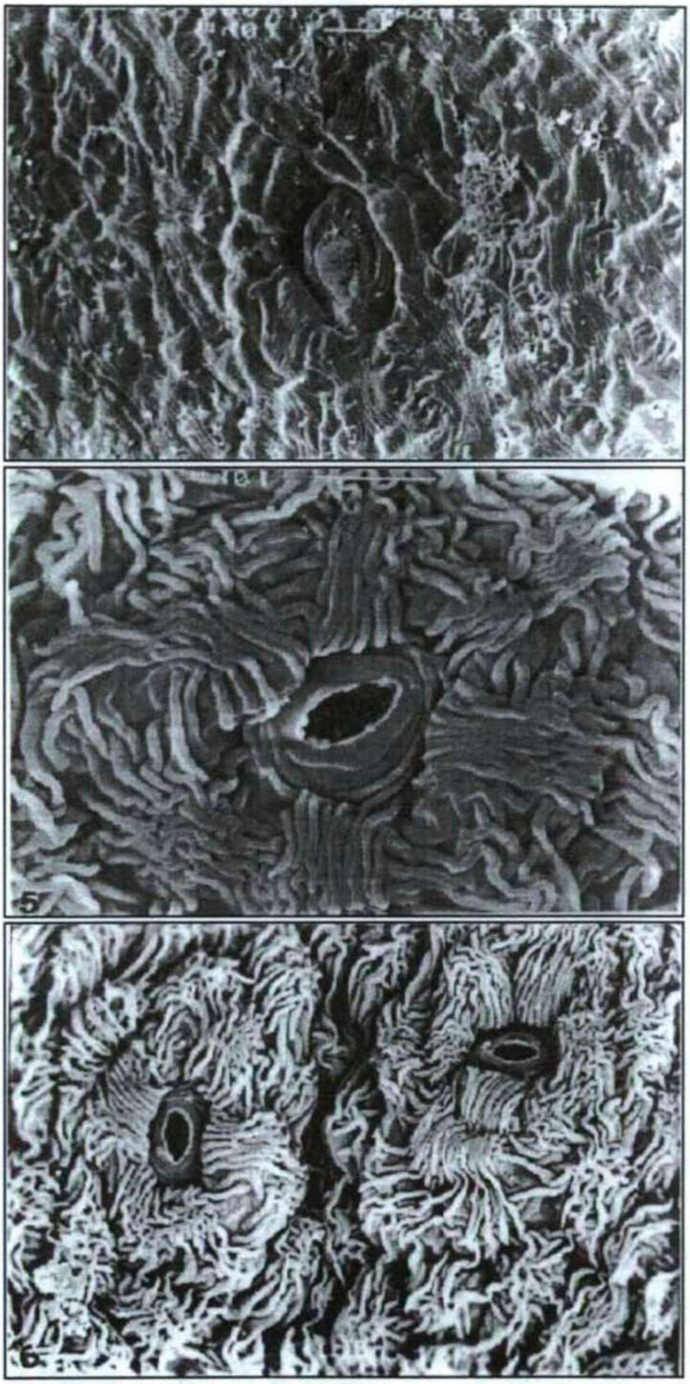
The cuticle is mostly striate, mesomorphic (Fig. 8) or xeromorphic (Figs. 6, 7), but rarely it may have a smooth surface, as well (Orosz-Kovács et al., 1990), in the case of a higromorphic epidermis (Fig. 4). At the Besztercei C. 35. clone both mesomorphic and xeromorphic stomata may occur (Figs. 5, 9).

On the gland surface of the Korai (Early) Besztercei TV-46 plum clone, which has higromorphic characteristics, the epidermal cells are covered uniformly by the lamina-like cuticle, and in most cases the surface is broken only by the cell borders (Fig. 4). The stomata of the mesomorphic Besztercei 142–59 plum clone are at the same level as the epidermal cells, the ribs of the cuticle are not too frequent, but regular (Figs. 2, 3, 8). At clones with characteristically xeromorphic epidermis, the stoma is sunken below the level of epidermis cells, and also the cuticular ribs are powerful, frequent and wavy, forming irregularly folded crests on the papillae of the epidermal cells. Such is the nectary epidermis of the Besztercei C-224 plum, having xeromorphic characteristics (Fig. 6).

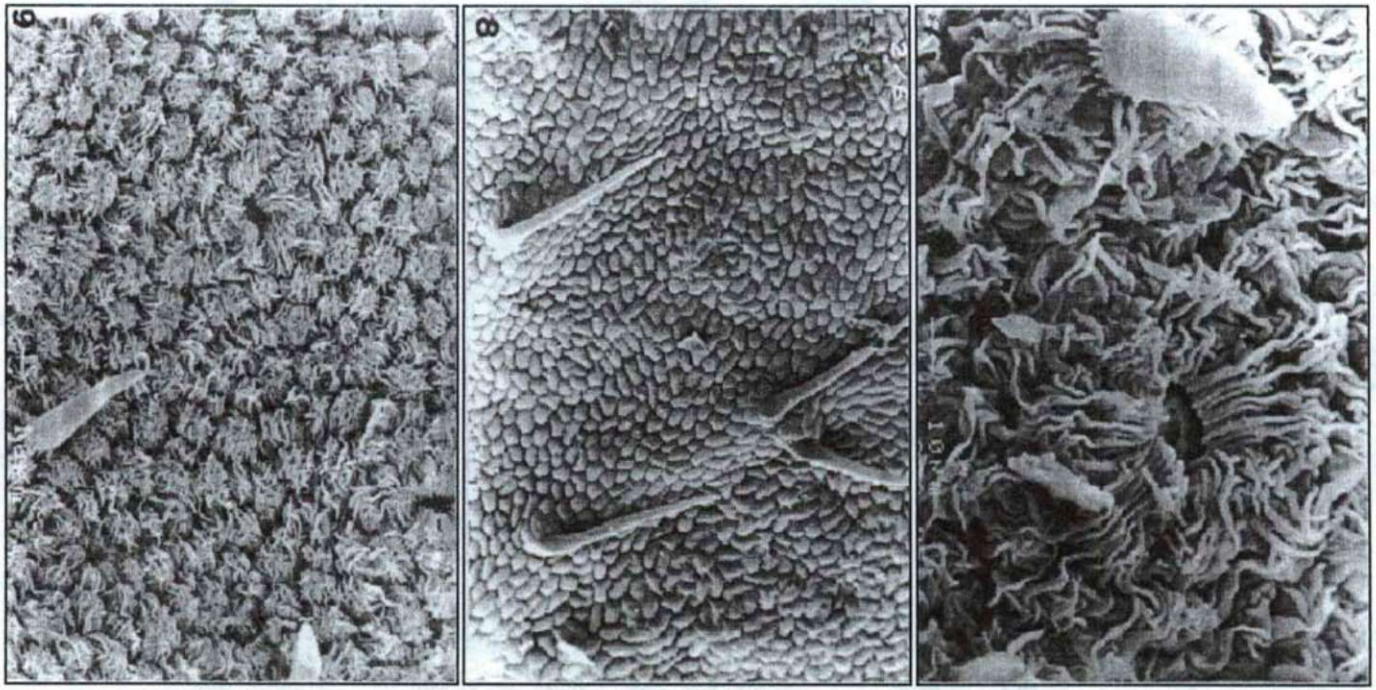
The cuticular ribs are often radially oriented around the stomata (Figs. 3, 5, 6, 7, 9), and the cuticular valleys, similarly to other Prunoideae taxa, act as micro-capillaries, distributing the secretory product evenly on the glandular surface, close to the stoma (Orosz-Kovács, 1990; Orosz-Kovács et al., 1990). The ribs are broken at the cell borders on the interstomatal epidermal cells (Figs. 2, 6). Ribs may occur sparsely or densely, they can be straight (Fig. 1) or twisted (Figs. 3, 5, 6, 7, 9).



Figs. 1–3: 1. Surface of the basal part of the intrafloral nectary in Besztercei 142–59 plum clone — mesomorphic type. 2. Surface of the apical part of the intrafloral nectary in Besztercei 142–59 plum clone — xeromorphic type. 3. A nectary stoma with the characteristic cuticular ribs on the surface of the apical part of the intrafloral nectary in Besztercei 142–59 plum clone — xeromorphic type.



Figs. 4–6: 4. Higromorphic nectary epidermis in Korai Besztercei TV-46 plum clone. 5. Mesomorphic nectary epidermis in Besztercei C. 35 plum clone. 6. Xeromorphic nectary epidermis with sunken stomata in Besztercei C. 224.



Figs. 7–9: 7. Short, thick, pointless trichomes on the xeromorphic nectary epidermis in Besztercei KD-10 plum clone. 8. Long, thin, tapering trichomes of the floral nectary epidermis in Besztercei 142–59 plum clone. 9. Short, thick and tapering trichomes of the intrafloral nectary of Besztercei C. 35 plum clone.

Around the stomata the cuticle often forms wrinkles in the shape of concentric circles (Figs. 3, 5). The nectar gap is mostly oval after the cuticle has been torn (Fig. 3).

At the Besztercei plum clones trichomes often occur on the nectary surface. These trichomes are coverhairs, they can be unior multicellular, short and thick, as e.g. at the Besztercei KD. 10 or C. 35. clones, or long and tapering, as in the case of the 142–59 clone (Fig. 8). The trichomes prevent nectar flowing out of the flower.

The results make clear that the intrafloral nectary surface at the clones of the Besztercei plum cultivar group is highly variable, although it concerns an intraspecific taxon. Cuticle ornamentation and the position of stomata in relation to the epidermal cells indicate primarily the ecotype, but the characteristics of each clone can be observed, too. For identification of a broad scale of clones, the study of further clones can be suggested.

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