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ARTICLE

Nectary structure of *Cotoneaster roseus*

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ABSTRACT Cotoneasters are widely planted as ornamentals, which at the same time can serve as a sources of nectar for honey bees and bumble bees. The present study gives a detailed description of the nectary anatomy of *Cotoneaster roseus*. The floral nectary is located within the receptacle, with well distinguishable regions of the epidermis, glandular tissue and nectary parenchyma. Modified nectary stomata are at level with or below the epidermis; the glandular cells are arranged in 3 to 4 subepidermal layers; and calcium oxalate crystals are typical in the nectary parenchyma. Data are provided on the size and thickness of the nectar gland, which can be significant factors determining the nectar producing ability of the flowers.
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KEY WORDS

cotoneaster
fire blight
honey bee
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nectary, stoma

Cotoneasters (*Cotoneaster* spp.) belong to the *Rosaceae* family, comprising both deciduous and evergreen shrubs that are widespread in the temperate regions of Europe and Asia, as well as in North-Africa (Fryer and Hylmö 2009). In Hungary various cotoneasters are frequently planted in gardens, parks and in the vicinity of various institutions or along roads, due to the ornamental value of their leaves, flowers and fruits alike.

Despite their small size, the flowers are able to secrete substantial amounts of nectar, with a fairly high sugar content of 15-40%, which makes them attractive both for honey bees (*Apis mellifera*) and bumble bees (*Bombus* sp.) (Corbet and Westgarth-Smith 1992; Weryszko-Chmielewska et al. 2003, 2004). Being a valuable bee pasture, planting cotoneaster shrubs would be desirable and profitable for apicultural purposes. On the other hand, cotoneasters belong to the genera being the most susceptible to fire blight (van der Zwet and Keil 1979; Roberts et al. 1998), and bees play an important role in transmitting the causing agent *Erwinia amylovora*. Therefore, cotoneasters should be avoided in the vicinity of orchards (Corbet and Westgarth-Smith 1992).

Different species produce highly varying amounts of nectar, which can be explained partly by the structural differences of their nectar glands, and partly by the actual environmental circumstances that will determine the volume and sugar concentration of the nectar produced by the flowers in the given year. The nectary of only a few cotoneaster species has been described so far: Weryszko-Chmielewska et al. (2003, 2004) reported on the anatomy and nectar production of the flowers in *C. hjelmquistii*, *C. lucidus* and *C. nanshan*. The present study gives the detailed anatomical description of the floral nectar glands in *C. roseus*, a species that has previously not been characterised from this aspect.

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Materials and Methods

The flowers of *C. roseus* Edgew. were sampled on two occasions, in May 2007 and June 2010, in the Botanical Garden in Vácrátót. Flower samples were dehydrated in ascending ethanol series, then embedded in paraplast (2007) or Technovit 7100 (Heraeus Kulzer, Wehrheim, Germany), a hydroxyethylmetachrylate based resin (2010). From the blocks 10 µm thick medial longitudinal sections were cut with a rotary microtome (Anglia Scientific 325). Sections were stained with toluidine blue, and mounted in Canada balsam. Slides were investigated with a NIKON ECLIPSE 80i microscope, and micrographs were taken with SPOT BASIC 4.0. Nectary area and thickness (at the thickest part of the gland) were measured with Image Tool 3.0 in 10 and 20 flowers in 2007 and 2010, respectively. Data were analyzed with Microsoft Excel.

Results

The floral nectary of *C. roseus* is lining the adaxial surface of the receptacle, between the ovary and the base of the stamens (Fig. 1). The protruding, automorphic gland can be easily distinguished from the surrounding tissues. In the longitudinal section of the flower the nectary epidermis cells are square or rectangular (Fig. 2). The guard cells of nectar secreting stomata are located at the same level as the epidermal cells (mesomorphic type, Fig. 3) or slightly below the level of the epidermis (xeromorphic type, Fig. 4). Subepidermally 3 to 4 layers of small, isodiametric cells can be observed, comprising the glandular tissue of the nectary (Fig. 2). Below the

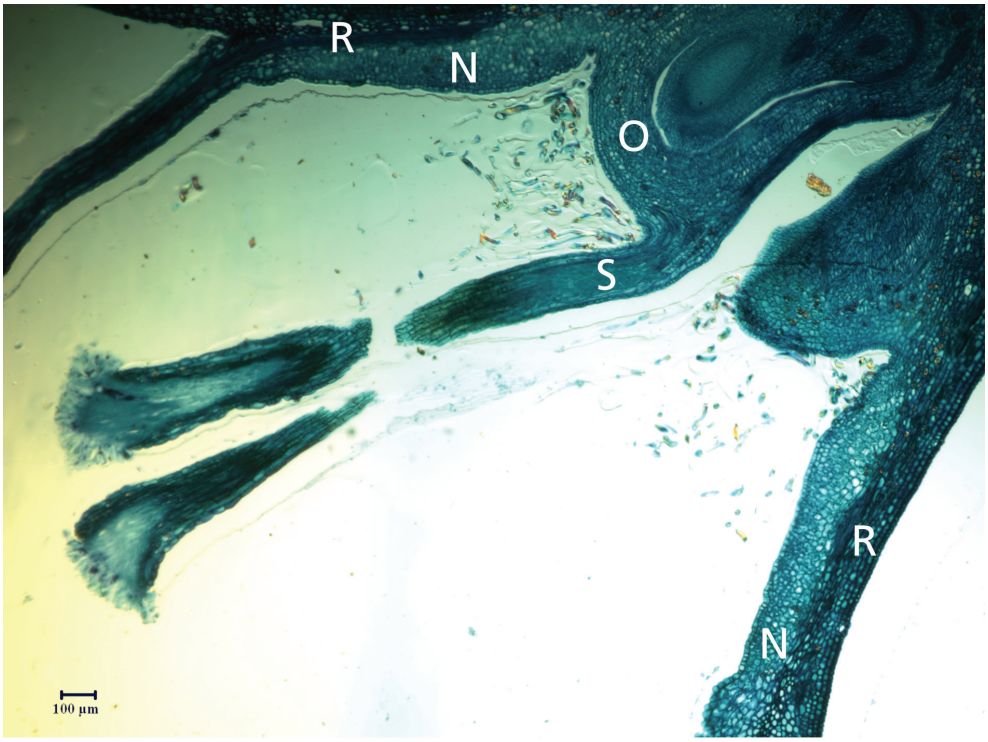

Figure 1. Automorphic nectary of *Cotoneaster roseus* in the longitudinal section of the flower. R: receptacle, N: nectary, S: style, O: ovary.

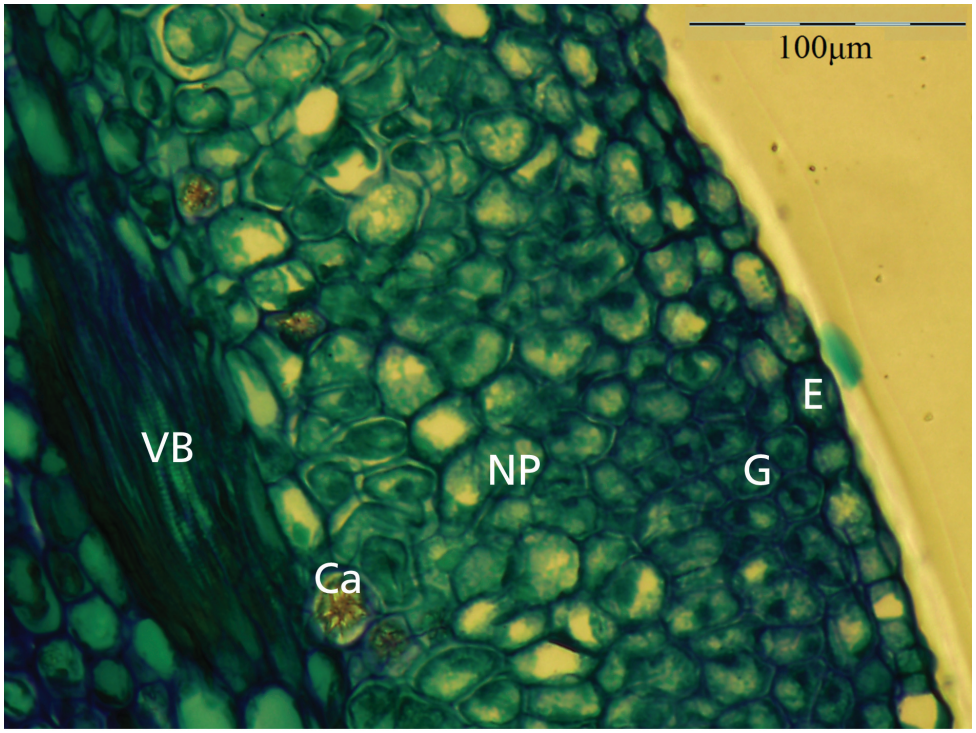

Figure 2. Structure of the floral nectary in *Cotoneaster roseus*. E: nectary epidermis, G: glandular tissue, NP: nectary parenchyma, Ca: calcium oxalate druse, VB: vascular bundle.

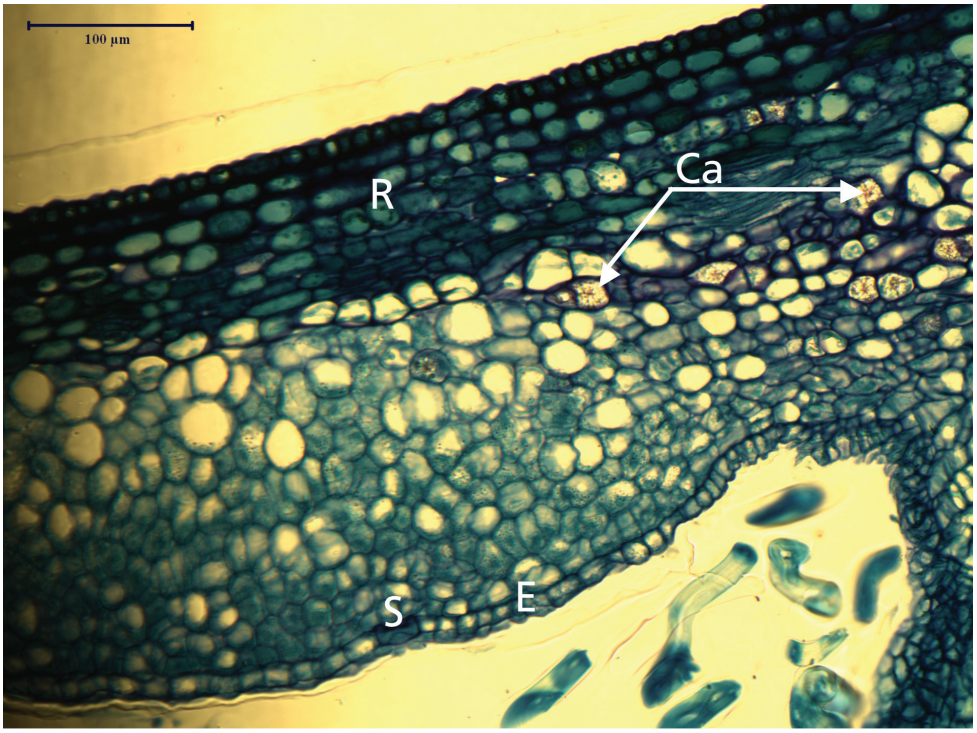

Figure 3. Nectary of *Cotoneaster roseus* with mesomorphic stoma. E: nectary epidermis, S: nectary stoma, R: receptacle.

glandular tissue the larger cells of the nectary parenchyma can be seen. The parenchymatous tissue of both the gland and the receptacle often contains idioblasts with calcium oxalate druses (Figs 2 and 3). Directly beneath the nectary parenchyma vascular bundles can be observed, where the annular cell wall thickening of xylem elements is characteristic (Figs 2 and 4).

The average size (area) of the nectary was below 200,000 µm^2 in both years of study (Table 1). From the 13 Cotoneaster species studied in 2007, *C. roseus* possessed the second smallest nectar gland (Farkas et al. 2010). The mean thickness values of the nectary – measured at the thickest part of the gland – were around 200 µm in both years (Table 1), and fell between 190 and 225 µm, measured at *C. lucidus* and *C. nanshan*, respectively (Weryszko-Chmielewska et al. 2004). From the cotoneasters studied by us in 2007, *C. roseus* was classified among taxa with thin nectar gland, whereas thickness values reached 240 to 250 µm in the group with thick nectary (Farkas et al. 2010).

Table 1. Area and thickness of the nectary in *Cotoneaster roseus* in 2007 and 2010.

	Mean ± SD (2007)	Mean ± SD (2010)
Area of nectary (µm^2)	186284.26 ± 25186.11	185077.30 ± 23860.28
Thickness of nectary (µm)	207.27 ± 16.05	192.34 ± 17.72

Discussion

Weryszko-Chmielewska et al. (2004) found a positive correlation between nectary size and nectar weight, as well as between the number of stomata in nectary epidermis and the weight of nectar. Similarly, our earlier experience and further authors (Gulyás and Kincsek 1982; Orosz-Kovács and Gulyás 1989; Orosz-Kovács et al. 1990; Petanidou et al. 2000; Chwil and Weryszko-Chmielewska 2009) also suggest that taxa with larger nectary and/or thicker glandular tissue produce more nectar than those with smaller glands and/or thinner glandular tissue. On the basis of the above relationship *C. roseus* is supposed to secrete low volumes of nectar. In the view of other, contradictory studies (Weryszko-Chmielewska et al. 1996), however, further investigations are needed to confirm if such a correlation exists between the size of glandular tissue and nectar production in *C. roseus*, as well. Although less nectar production and the expected smaller degree of bee attraction is disadvantageous from the aspect of apiculture, at the same time it can reduce the chances of bees transmitting fire blight causing bacteria in the vicinity of orchards. Additionally, due to attracting smaller number of bees, planting of C. roseus

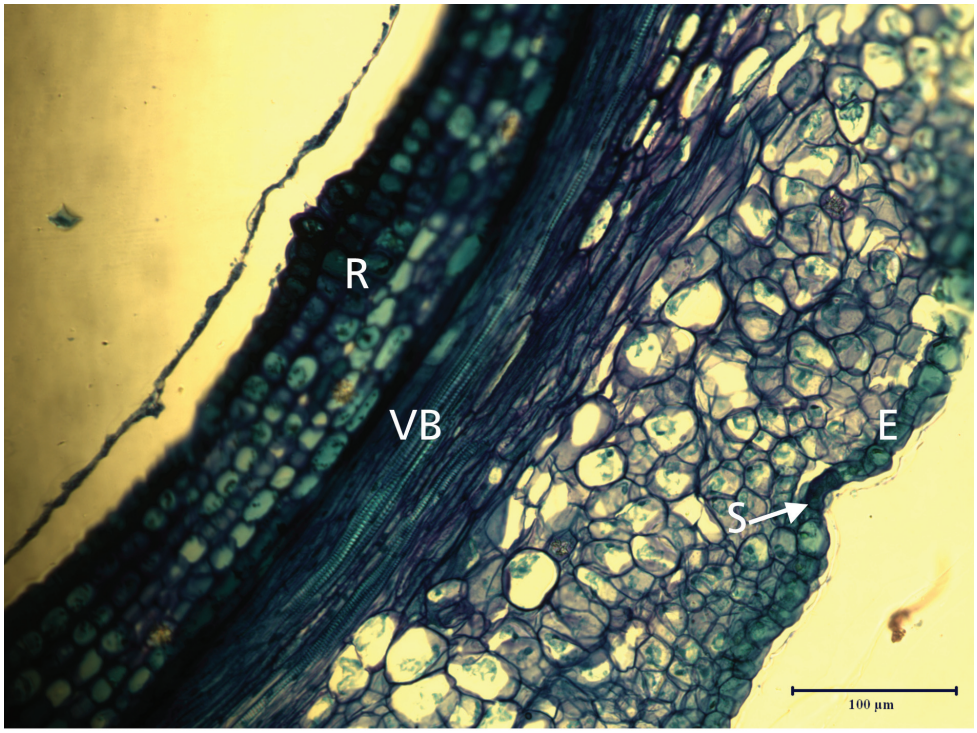

Figure 4. Nectary of *Cotoneaster roseus* with xeromorphic stoma. E: nectary epidermis, S: nectary stoma, VB: vascular bundle, R: receptacle, Ca: calcium oxalate druse.

seems to be safer along roads, in parks and around childcare institutions.

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References

Chwil M, Weryszko-Chmielewska E (2009) Characteristics of nectaries and nectar in flowers of two Rhododendron species. J Apic Sci 53:17-27.

Corbet SA, Westgarth-Smith A (1992) Cotoneaster for bumble bees and honey bees. J Apic Res 31:9-14.

Farkas Á, Nagy Tóth E, Kósa G (2011) Madárbirs (Cotoneaster) fajok nektáriumszerkezete. XIV. Apáczai Napok Nemzetközi Tudományos Konferencia 2010 Tanulmánykötet: pp. 912-919.

Fryer J, Hylmö B (2009) Cotoneasters: A Comprehensive Guide to Shrubs for Flowers, Fruit, and Foliage. Timber Press Inc., London, 2009. p. 344.

Gulyás S, Kincsek I (1982) Floral nectaries of species of Papilionaceae. Acta Biol Szeged 28:53-63.

Orosz-Kovács Zs, Gulyás S (1989) Floral nectaries and nectar production of sour cherry cv Pándy clones. Acta Bot Hung 35:227-236.

Orosz-Kovács Zs, Nagy Tóth E, Csatos A, Szabó A (1990) A nektárium-szerkezet és a nektárprodukció összefüggése néhány almafajtánál. Bot Közl 77:127-132.

Petanidou T, Goethals V, Smets E (2000) Nectary structure of Labiatae in relation to their nectar secretion and characteristics in a Mediterranean shrub community: does flowering time matter? Plant Syst and Evol 225:103-118.

Roberts RG, Hale CN, van der Zwet T, Miller CE, Redlin SC (1998) The potential for spread of Erwinia amylovora and fire blight via commercial apple fruit; a critical review and risk assessment. Crop Protection 17:19-28.

van der Zwet T, Keil HL (1979) Fire blight: A bacterial disease of rosaceous plants. In: Agriculture Handbook. Vol. 510. United States Department of Agriculture, Washington DC.

Weryszko-Chmielewska E, Masierowska M, Konarska A, Pezda M (1996) Wielkosc nektarników i obfitosc nektarowania niektórych gatunków Cotoneaster, Crataegus i Sorbus. Ann Univ Marie Curie Sklodowka Sect EEE 17:133-140.

Weryszko-Chmielewska E, Chwil M, Skrzypek H (2003) Charakterystyka kwiatów i nektarowanie irgi miseczkowatej (Cotoneaster hjelmquistii). Ann Univ Mariae Curie-Sklodowska Sect EEE 13:137-142.

Weryszko-Chmielewska E, Chwil M, Konarska A (2004) Anatomical traits of nectaries and nectar secretion by the flowers of Cotoneaster lucidus Schlecht. and C. nanshan Mottet. J Apic Sci 48:55-62.