Floral Nectar Production and Nectar Sugar Composition of *Cotoneaster* Species as Determined by Structural and Environmental Features

Erika NAGY TÓTH[a], Ágnes FARKAS[b], Géza KÓSA[c] ***E-mail:nterika@ttk.nyme.hu***

[a]Institute of Biology, Faculty of Natural Sciences, University of West Hungary, Szombathely, Hungary
[b]Department of Pharmacognosy, Medical School, University of Pécs, Pécs, Hungary
[c]Botanical Garden in Vácrátót, Institute of Ecology and Botany of the Hungarian Academy of Sciences, Vácrátót, Hungary

INTRODUCTION

The *Cotoneaster* genus (Rosaceae) comprises popular ornamentals, widespread in the temperate regions of Europe and Asia (Fryer – Hylmö 2009). The small flowers can secrete large volumes of nectar with sugar concentrations that are sufficiently high to attract honey bees (*Apis mellifera*) (Weryszko-Chmielewska et al. 2003, 2004) and bumble bees (*Bombus* sp.) (Corbet – Westgarth-Smith 1992). At the same time, cotoneasters are among the plant taxa that are the most susceptible to fire blight (van der Zwet – Keil 1979, Roberts et al. 1998), and bees play an important role in transmitting the causing agent *Erwinia amylovora*.

The varying nectar producing capacity of different *Cotoneaster* species might 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. In order to determine which factors are decisive for nectar production in cotoneasters, we investigated the nectary structure, as well as the sugar value and composition of the nectar in several *Cotoneaster* species in three years.

MATERIALS AND METHODS

Investigations were performed on 13, 22 and 31 *Cotoneaster* species in 2007, 2010 and 2011, respectively, in the Vácrátót Botanical Garden, Hungary.

Nectary structure was investigated by light microscopy and scanning electron microscopy.

Nectar volumes were determined with calibrated glass capillaries, following 24-hour isolation of the flowers. **Sugar concentration** was measured with a hand refractometer. **Sugar value** was calculated using the formula: nectar volume (µl) * nectar concentration (%)/100.

Nectar sugar composition was analysed with thin layer chromatography and densitometry.

RESULTS

Nectary Structure

The floral nectary of cotoneasters is automorphic and receptacular, positioned between the ovary and the base of the stamens (*Fig. 1*). The cuticle covering the nectary surface has an irregular ornamentation consisting of wrinkles and creases (*Fig. 2*).

Nectar is secreted through stomata, whose guard cells are either in level with the epidermal cells or slightly below the level of the epidermis (*Fig. 3*).

Subepidermally, 3 to 4 layers of small, isodiametric cells comprise the glandular tissue; followed by the larger cells of nectary parenchyma (*Fig. 4*). Calcium oxalate druses frequently occur in the parenchymatous tissues of both the gland and the receptacle. Directly beneath the nectary parenchyma vascular bundles can be observed.

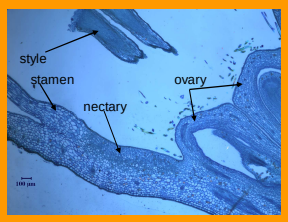

Fig. 1.* Nectary of *C. lancasteri

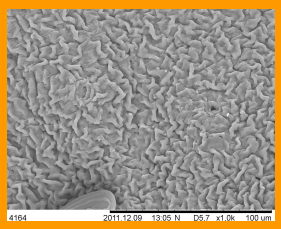

Fig. 2.* Nectary surface of *C. kitaibelii

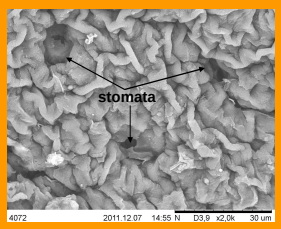

Fig. 3.* Nectary stomata of *C. hissaricus

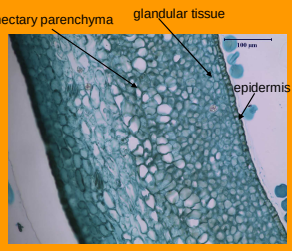

Fig. 4.* Nectary structure of *C. glomerulata

Significant differences were found among *Cotoneaster* species, regarding both the total area (*Fig. 5, 6*) and the largest thickness of the nectary (*Table 1)*, both in 2007 and 2010.

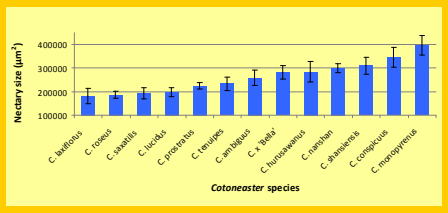

***Fig. 5.* Total area of the nectary in *Cotoneaster* flowers (Vácrátót, 2007)**

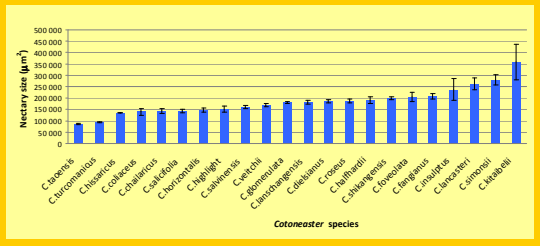

***Fig. 6.* Total area of the nectary in *Cotoneaster* flowers (Vácrátót, 2010)**

***Table 1.* Thickness of the nectary in *Cotoneaster* flowers in Vácrátót in 2007 and 2010**

Cotoneaster species	Nectary thickness (µm) 2007 (mean ± SE)	*Cotoneaster* species	Nectary thickness (µm) 2010 (mean ± SE)
C. laxiflorus	167.91 ± 20.70	*C. taoensis*	81.51 ± 2.97
C. lucidus	188.26 ±20.41	*C. turcomanicus*	89.05 ± 2.27
C. saxatilis	188.32 ±22.23	*C. hissaricus*	104.82 ± 3.81
C. prostratus	195.48 ±30.17	*C. coriaceus*	113.61 ± 8.19
C. tenuipes	199.76 ±27.59	*C. salicifolia*	122.03 ± 4.84
C. roseus	207.27 ± 16.05	*C. fangianus*	127.14 ± 6.83
C. shansiensis	212.49 ± 16.51	*C. salvinensis*	128.11 ± 8.92
C. ambiguus	222.25 ± 42.89	*C. dielsianus*	133.82 ± 5.10
C. x 'Bella'	225.01 ± 15.46	*C. halfhardii*	140.13 ± 9.9
C. nanshan	229.79 ± 29.64	*C. chailaricus*	151.75 ± 12.45
C. conspicuus	236.87 ±13.02	*C. glomerulata*	152.00 ± 12.06
C. monopyrenus	244.12 ± 26.22	*C. veitchii*	152.06 ± 7.39
C. hurusawanus	256.42 ± 49.17	*C. horizontalis*	157.00 ± 16.85
		C. highlight	157.40 ± 10.77
		C. foveolata	170.33 ± 10.08
		C. shikangensis	176.75 ± 4.26
		C. lancasteri	185.20 ± 11.93
		C. lanshangensis	191.18 ± 4.86
		C. insuiptus	191.25 ± 28.22
		C. roseus	207.27 ± 5.07
		C. simmonsii	221.59 ± 20.85
		C. kitaibelii	238.00 ± 44.68

Nectar Production

Cotoneaster species with large nectaries (above 250,000 µm2) produced an average of 10-18 µl nectar per flower per day, whereas smaller nectaries (below 200,000 µm2) were able to produce about 5 µl nectar. Sugar concentration of the nectar varied from 13 to 45%, while sugar value was in the range of 0.5-3.2 mg in 2011.

Nectar Sugar Composition

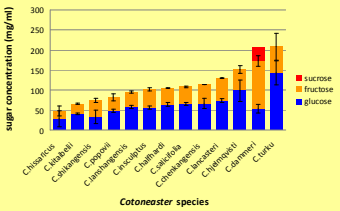

Fig. 7.* Nectar sugar composition of *Cotoneaster

The nectar of all examined species was hexose-dominant, except for *C. dammeri*, whose nectar contained the disaccharide sucrose in addition to the hexoses glucose and fructose (*Fig. 7*).

CONCLUSION

Nectar secretion in *Cotoneaster* species was found to be influenced both by structural features, such as the size and thickness of the nectary, and environmental factors like air temperatures. Cotoneasters with large nectar and sugar producing capacity are suitable for apicultural purposes, whereas taxa with lower nectar volumes can be recommended as ornamentals.

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