

THE BLOOMING, NECTAR SECRETION AND FORAGING BY BEES OF THREE SPECIES OF *AGASTACHE*

Bolesław Jabłoński, Zbigniew Koltowski

Research Institute of Pomology and Floriculture, Apiculture Division,
Kazimierska 2 Str., 24-100 Puławy, POLAND
e-mail: zbigniew.koltowski@man.pulawy.pl

S u m m a r y

About 20 species of perennials growing mostly in Northern America belong to the genus *Agastache* (family *Labiatae*). All of them are good or very good honey-yielding plants and some are cultivated specially as bee forage. The abundance of nectar secretion and bee foraging on flowers of the 3 best species: *A. foeniculum* (Pursh.) Kuntze, *A. rugosa* (Fisch. et C.A. Mey.) Kuntze and *A. nepetoides* (L.) Kuntze were estimated in years 1997-1999 in Puławy. The present practical methods in bee botany were used in those investigations.

It was found that *A. foeniculum* blooms in Poland from mid-June to the end of July, *A. rugosa* - from the beginning of July to mid-August, and *A. nepetoides* - from the third decade of July to the end of August. One flower of the first species secreted on average 0.49 mg of sugars, the second - 0.33 mg and the third one - 0.38 mg. Sugar yield in nectar for the whole blooming period per 1 hectare amounted to 745 kg, 538 kg and 394 kg for *A. foeniculum*, *A. nepetoides* and *A. rugosa*, respectively. Flowers were foraged by bees from the morning to the evening. At around noon 30-50 honeybees, nectar and pollen collectors, worked per 1 m². The *Agastache* flowers were also readily visited by bumblebees and by solitary bees. All of these three species can be recognized in Polish conditions as very good honey plants. However *A. nepetoides* proved to be a short-living perennial plant.

Keywords: *Agastache*, blooming, nectar secretion, foraging by bees.

INTRODUCTION

About 20 species of perennials belong to the genus *Agastache* (family *Labiatae*). They are grown in North America from the southern part of Canada to Mexico, and one species in East Asia. All of them supply nectar and pollen to bees and apicultural literature informs that five of them are good or very good honey-yielding plants. These are following: *Agastache foeniculum* (Pursh.) O. Kuntze, *A. urticifolia* (Benth.) O. Kuntze, *A. nepetoides* (L.) O. Kuntze, *A. rugosa* (Fisch. et C.A. Mey.) O. Kuntze and more seldom *A. scrophularifolia* (Wilde) O. Kuntze. For several years some studies have been conducted in the United States of America on possibilities of using these plants not only in beekeeping production (Pellet 1947, Ayers & Widrlechner 1994 a, b, c) but also as a herbal and industrial product

(Nykänen et al. 1989, Wilson et al. 1992, Fuentes-Granados et al. 2000). Lately in Russia some species of *Agastache* (probably *A. nepetoides*) are mentioned as melliferous and therapeutic plants (Šibajev 1997).

The beekeeping value of the two best American species *A. foeniculum* (Pursh.) Kuntze, and *A. nepetoides* (L.) Kuntze, and one Asiatic species *A. rugosa* (Fisch. et C.A. Mey.) Kuntze were estimated in Puławy in years 1997-1999. The present report shows results of the studies obtained in the years 1997-1999.

MATERIAL AND METHODS

The samples of seeds of *Agastache foeniculum* and *A. rugosa* reached Puławy in the eighties from Botanical Garden in Warsaw and from Norway, and *A. nepetoides* straight from the USA in 1993. The plants grew on light podsolic soil, rated class IV on the land valuation scale, cultivated similarly as in the garden. Seeds of *Agastache foeniculum* and *A. rugosa* were sowed in spring directly into the field in rows 40 cm wide. Seeds of *A. nepetoides*, which germinate weakly in the field, were planted from seedlings produced in a greenhouse. Cultivation work was limited to manual removing of weeds. Typical observations of some details of blooming biology and bee foraging on flowers were executed in the second or the third year of vegetation, during full blooming period. The investigations of abundance of nectar secretion (by pipette method) were conducted, too. Number of flowers produced per unit of field surface was fixed at the latter part of the blooming period.

RESULTS

The investigated species bloomed in Puławy on average from mid-June to the end of October. The blooming period of each investigated species lasted about 5-6 weeks. *A. foeniculum* blooms in Poland as the first, and *A. nepetoides* as the last one. All of them produced over 10^5 flowers per 1 square meter of plot (Table 1).

It was found that examined species are characterised by the same diurnal dynamics of blooming (with its top intensity between 9 and 12 a.m.) and similar course of foraging flowers by insects during the day (with top between 9 a.m. and 3 p.m.) - Fig.1. The *Agastache* flowers secrete nectar and deliver pollen for bees just after starting to bloom. The length of their life is in most cases one day only. In the second day their corollas fade and drop down. *Agastache* flowers were readily foraged, besides of honeybees collecting nectar and pollen (cream-white coloured loads), by bumblebees and some solitary bees. About 30 to 40 honeybee foragers worked simultaneously per 1 square meter of plot during top hours of foraging.

Table 1

The time and blooming abundance of the 3 species of *Agastache* in Puławy in years 1997-1999 - Pora i obfitość kwitnienia 3 gatunków kłosowca w Puławach w latach 1997-1999

Species of plant Gatunek rośliny	Year of study Rok badań	Time of blooming Pora kwitnienia	Number per 1 m ² : - Liczba na 1 m ² :		
			plants roślin	sprouts pędów	flowers in 10 ³ kwiatów w tys.
<i>Agastache foeniculum</i> (Pursh.) O. Kuntze	1997	19.06 - 8.08	71	142	150.1
	1998	10.06 - 25.07	25	153	164.6
	1999	18.06 - 30.07	62	120	138.7
	Average Średnio	16.06 - 31.07	53	138	151.1
<i>Agastache rugosa</i> Fisch. et C.A. Mey.	1997	9.07 - 27.08	64	118	149.6
	1998	2.07 - 5.08	95	125	94.8
	1999	5.07 - 15.08	80	80	85.2
	Average Średnio	5.07 - 17.08	80	108	109.9
<i>Agastache nepetoides</i> (L.) O. Kuntze	1997	28.07 - 26.08	4	17	183.2
	1998	23.07 - 5.09	6	13	108.0
	1999	29.07 - 30.08	6	16	120.4
	Average Średnio	27.07 - 31.08	5	15	137.2

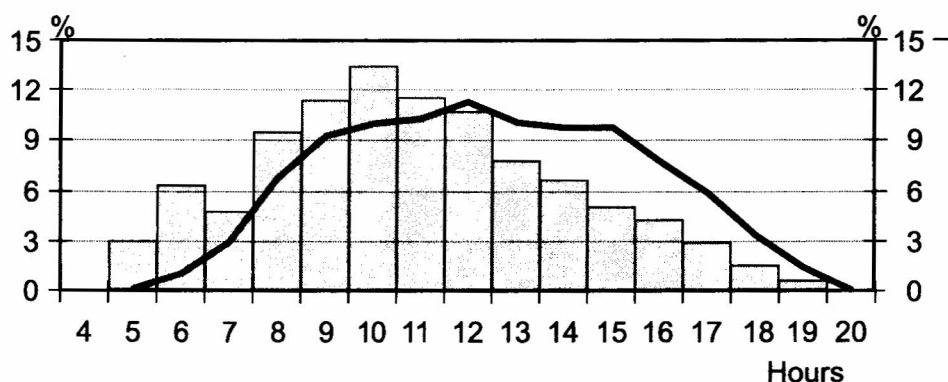


Fig.1. Diurnal dynamics of blooming and bee foraging on flowers (average for the 3 species of *Agastache*): bars show the number of blooming flowers in 1-hour intervals in relation to sum of flowers blooming per plot during the whole day in %, the line shows similarly the density of honeybees per plot in %

Dzienna dynamika rozkwitania i oblotu przez pszczoły kłosowców (na podstawie średnich dla 3 gatunków): słupki przedstawiają liczbę kwiatów rozkwitających w godzinnych odcinkach czasu, wyrażoną w procentach w stosunku do sumy kwiatów rozkwitłych w ciągu całego dnia na poletku doświadczalnym, a linia krzywa analogicznie zagęszczenie pszczół pracujących na poletku

One flower of investigated *Agastache* species secreted on average 0.40(0.22-0.68) mg of sugars with their concentration in nectar from 33 to 67% (Table 2). Yield of sugars in nectar for the whole blooming period per 1 hectare was on average 745 kg, 538 kg and 394 kg for *A. foeniculum*, *A. nepetoides* and *A. rugosa* respectively. *A. rugosa* distinguishes itself by the best persistence as a perennial plant, while *A. nepetoides* in Puławy showed clear features of a biennial. If sowed directly into the field it germinated weakly, unevenly and grew very slowly at the beginning.

Table 2

The abundance of nectar secretion and sugar yield of the 3 species of *Agastache* examined in Puławy in years 1997-1999
Obfitość nektarowania i wydajność cukrowa 3 gatunków kłosowca badana w Puławach w latach 1997-1999

Species of plant Gatunek rośliny	Year of study Rok badań	Sugars concentration in nectar in % Koncentracja cukrów w nektarze w %	Mass of sugars per 10 flowers in mg Ilość cukrów z 10 kwiatów w mg		Sugars efficiency in kg/ha Wydajność cukrów w kg/ha
			min - max min.-maks.	average Średnio	
<i>Agastache foeniculum</i> (Pursh.) O. Kuntze	1997	33 - 57	1.7 - 5.5	3.49	524
	1998	45 - 70	3.6 - 8.1	5.70	938
	1999	67 - 73	4.4 - 6.7	5.58	774
	Average Średnio	48 - 67	3.2 - 6.8	4.92	745
<i>Agastache rugosa</i> Fisch. et C.A. Mey.	1997	28 - 69	1.9 - 5.5	2.43	513
	1998	44 - 56	1.9 - 5.3	3.29	312
	1999	28 - 70	2.7 - 5.3	4.20	358
	Average Średnio	33 - 65	2.2 - 5.4	3.31	394
<i>Agastache nepetoides</i> (L.) O. Kuntze	1997	45 - 65	2.7 - 5.3	4.23	775
	1998	31 - 69	1.9 - 3.8	2.83	306
	1999	42 - 57	3.4 - 6.0	4.44	534
	Average Średnio	39 - 64	2.7 - 5.0	3.83	538

CONCLUSIONS

Each from the 3 investigated species of *Agastache* blooms abundantly through 5-6 weeks of summer time, whereas *A. foeniculum* from mid-June, *A. rugosa* from the beginning of July and *A. nepetoides* from the end of July.

All of the 3 investigated species supply large quantities of nectar to bees willingly collected by insects and also some quantities of pollen.

A. foeniculum and *A. rugosa* are direct-seeded crops and they are quite persistent. They can be suitable for cultivation on not very poor soils to improve bee forage flow. *A. nepetoides* should be tested for this purpose yet.

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KWITNIENIE, NEKTAROWANIE I OBLÓT PRZEZ PSZCZOŁY TRZECH GATUNKÓW KŁOSOWCA (*AGASTACHE* KUNTZE)

Jabłoński B., Kołtowski Z.

Streszczenie

Do rodzaju *Agastache* (rodzina *Labiatae*) należy około 20 gatunków bylin występujących głównie w Ameryce Północnej. Wszystkie są dobrymi lub bardzo dobrymi roślinami miododajnymi. Niektóre opłaca się uprawiać specjalnie na użytek pszczeli. W latach 1997-1999 w Puławach oceniano obfitość nektarowania i oblot przez pszczoły 3 najlepszych gatunków: *A. foeniculum* (Pursh.) Kuntze, *A. rugosa* (Fisch. et C.A. Mey.) Kuntze i *A. nepetoides* (L.) Kuntze. W badaniach posługiwano się aktualnie stosowanymi w botanice pszczelarskiej metodami.

Stwierdzono, że *A. foeniculum* kwitnie u nas od połowy czerwca do końca lipca, *A. rugosa* - od początków lipca do połowy sierpnia, a *A. nepetoides* - od trzeciej dekady lipca do końca sierpnia. Jeden kwiat pierwszego gatunku wydzieliał średnio 0,49 mg cukrów, drugiego 0,33 mg, a trzeciego - 0,38 mg. Wydajność cukrów w nektarze za cały okres kwitnienia w przeliczeniu na 1 ha wynosiła dla *A. foeniculum* - 745 kg, *A. nepetoides* - 538 kg i *A. rugosa* - 394 kg. Oblot kwiatów przez pszczoły trwał od rana do wieczora. W

środkowej porze dnia pracowało na 1 m² 30-50 zbieraczek nektaru i pyłku. Kwiaty *Agastache* były chętnie odwiedzane także przez trzmiele i pszczoły samotnice. Wszystkie trzy gatunki można uznać w naszych warunkach za bardzo dobre rośliny pożytkowe. *A. nepetoides* okazał się jednak byliną krótkotrwałą.

Słowa kluczowe: kłosowce, kwitnienie, nektarowanie, oblot przez pszczoły.