

## NECTAR SECRETION AND HONEY POTENTIAL OF HONEY-PLANTS GROWING UNDER POLAND'S CONDITIONS – Part XV

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### S u m m a r y

In the years 2000-2004 11 herbaceous plant species growing on a light podzolic soil in Puławy were tested for their beekeeping value.

It was found that the total amount of sugars secreted on the 10-flower basis was ca. 0.4 mg for *Eupatorium cannabinum*, 1-2 mg for *Anthyllis vulneraria*, 2-3 mg for *Onopordon acanthium* and *Trifolium incarnatum*, 4-6 mg for *Dahlia variabilis*, *Echinacea purpurea* and *Silphium perfoliatum*, 20-30 mg for *Echinops ruthenicus*, *Lathyrus silvester* and *Sida hermaphroditis*, ca. 40 mg for *Echinops ritro*. The amounts of sugars yielded by 1 ha of a dense stand of *Anthyllis* and *Lathyrus* were ca. 50(60) kg, *Onopordon* 90 kg, *Trifolium* 110 kg, *Eupatorium* 130 kg, *Dahlia* and *Echinacea* 150 kg, *Echinops ruthenicus* and *Sida* 180(190) kg, *Echinops ritro* 380 kg, *Silphium* 450 kg. The flowers of the surveyed species were visited from morning until evening mainly by the honeybee and also by wild bee-like insects as well as by *Diptera*, that were interested in nectar and in pollen.

In principle, all species tested in this survey deserve the attention of beekeepers because in the areas of their occurrence they enrich nectar flows and the forage supply to insect pollinators in general.

**Keywords:** melliferous plants, blooming, nectar secretion, visitation by bees.

### INTRODUCTION

This study as part XV is a continuation of the investigations on nectar secretion started by Demianowicz (1966) 50 years ago. Here is reported a three year-long survey of 11 herbaceous species four of which (*Anthyllis vulneraria*, *Onopordon acanthium*, *Lathyrus silvester* and *Eupatorium cannabinum*) occur in this country as wild species. The remaining taxons are cultivated (*Trifolium incarnatum* – as a fodder crop, *Dahlia variabilis*, *Echinops ritro* and *E. ruthenicus* – as ornamentals, *Echinacea purpurea* – as an ornamental and medicinal crop, and *Sida hermaphroditis* and *Silphium perfoliatum* – as possible future fodder and industrial crops). *Sida* and *Silphium* were

investigated for their beekeeping value before (Wróblewska 1986, 2000), it is only now that the remaining species have been surveyed in this respect.

### METHODS

The data were collected in the years 2000-2004. All the surveyed plants were grown on the plots of the collection of melliferous plants maintained by the Apiculture Division, Research Institute of Pomology and Floriculture, on a light podzolic soil rated as class IV, only *Lathyrus silvester* was grown on a class V soil. Each spring, the plots were topdressed with “Azofoska” – a multi-component fertilizer. The management of the plants during their growth was reduced to weed

control by hoe or hand cultivator. Observations and measurements were done according to methods currently used in beekeeping botany (Jabłoński 2002, 2003).

## RESULTS

### Blooming

Of the species studied *Anthyllis* was the first to come into flower – on average it started to bloom on May 25 and continued blooming for ca. 40 days (Table 1). In terms of the start of blooming date it was succeeded by *Onopordon* (June 12 and 44 days, respectively), *Lathyrus* (June 24 and 53 days), *Trifolium incarnatum* (June 30 and 27 days), *Sida* (July 1 and 58 days), *Silphium* (July 1 and 59 days), *Eupatorium* (July 5 and 47 days), *Echinacea* (July 9 and 43 days), *Dahlia* (July 12 and 61 days), *Echinops ritro* (July 15 and 39 days), and *Echinops ruthenicus* (July 29 and 30 days).

A fairly good stand of *Lathyrus* produced on average ca. 2,000 flowers per 1 m<sup>2</sup>, *Sida*, *Echinops ritro* and *E. ruthenicus* – produced ca. 8,000, *Dahlia*, *Echinacea*, *Onopordon*, *Trifolium* and *Anthyllis* – produced ca. 30,000-40,000, *Silphium* – produced ca. 70,000 and *Eupatorium* – 300,000 flowers per 1 m<sup>2</sup>.

### Nectar secretion

The concentration of sugars in nectar of the species under survey varied from 20(40)% do 50(70)%, most frequently from 40 to 60% (Table 1). The large variation of that trait is understandable since it is strongly dependent on relative air humidity. The total average amount of sugars per 10 flowers was ca. 47 mg (variation among years from 39 to 54 mg) for *Echinops ritro*. The respective values for the other species were 30 mg (18-36 mg) for *Sida*, 26 mg (23-28 mg) for *Lathyrus*, 21 mg (12-33 mg) for *Echinops ruthenicus*, 6 mg (4-8 mg) for *Silphium*, 5

mg (3-6 mg) for *Dahlia* and *Echinacea*, 3 mg (2-4 mg) for *Trifolium incarnatum*, below 3 mg (2-3 mg) for *Onopordon*, 1.5 mg (0.5-2 mg) for *Anthyllis*, and 0.4 mg (0.38-0.45 mg) for *Eupatorium*. The differences in nectar secretion among the study years were influenced mainly by different weather conditions during the blooming period. Abundant nectar secretion were always favoured by sunny weather and ample moisture supply in the soil.

### Honey output

By the concept of “honey output by the plant” is meant the amount of the dry nectar matter (or sugars) that is yielded by 1 ha of a given crop during its blooming and expressed in terms of honey product containing 80% of sugars (comparable to mature honey). The average honey output from 1 ha was 70 kg for *Anthyllis* and *Lathyrus*, 110 kg for *Onopordon*, 140 kg for *Trifolium incarnatum*, 170 kg for *Eupatorium*, 190 kg for *Dahlia* and *Echinacea*, 220 kg for *Echinops ruthenicus*, 230 kg for *Sida*, 470 kg for *Echinops ritro*, 560 kg for *Silphium* (Table 1).

The differences in honey output among study years within a range of 20-30(40)% for *Ornopodon*, *Lathyrus*, *Trifolium* and *Eupatorium* came, and 50-70(80)% for *Sida*, *Silphium*, *Dahlia* and both *Echinops* species. For *Echinacea* and *Anthyllis* they were above 300 and 400%. The large year-to-year variation in honey output for *Anthyllis* and *Echinacea* was mainly due to poor nectar secretion by the flowers of those species in the first study year.

The average daily honey output during the profuse blooming period was 2-3 kg for *Lathyrus*, *Anthyllis* and *Onopordon*, 4-5 kg for *Dahlia* and *Eupatorium*, 6-7 kg for *Echinacea*, *Sida* and *Trifolium incarnatum*, 10-13 kg for *Echinops ruthenicus* and *Silphium* and ca. 16 kg for

*Echinops ritro*. Those data give the idea of the magnitude of forage provided to bees during one day.

### Visitation by insects

No detailed records of the visitation by insects of the species were taken. A general observation was that during favourable

weather they were visited mainly by honeybees and (with the exception of *Eupatorium*) by bumblebees, as well as by solitary bees and *Diptera*. The latter insects frequently dominated on the plots planted by *Eupatorium* and *Echinacea*. The foraging lasted from morning until evening. The bee-like insects foraged for

Table 1  
Time and abundance of blooming, nectar secretion and sugar potential  
of 11 species of plants investigated in Puławy in 2000-2004

Plant species	Year of study	Height of plant in cm	Blooming period	Number of plants (and sprouts) per 1 m <sup>2</sup>	Number of flowers per 1 m <sup>2</sup>	Sugars content in nectar in %	Amount of sugars per 10 flowers in mg		Sugars (and honey) potential in kg per 1 ha
							min – max	average	
<i>Anthyllis vulneraria</i> L.	2000	40	17.05 – 3.07	6 (317)	56 426	17 - 41	0.3 - 1.0	0.44	25 (31)
	2001	45	15.06 – 12.07	10 (250)	22 340	33 - 50	1.2 - 3.9	2.11	47 (59)
	2003	40	31.05 – 8.07	7 (184)	47 395	46 - 67	1.2 - 3.7	2.22	105 (131)
<i>Onopordon acanthium</i> L.	2002	170	15.06 – 20.07	1 (3)	34 560	23 - 38	1.9 - 5.2	2.99	103 (129)
	2003	200	21.05 – 25.07	4 (5)	43 084	31 - 52	0.7 - 4.2	1.95	84 (105)
	2004	190	2.07 – 1.08	2 (3)	22 958	34 - 51	1.5 - 4.7	3.30	76 (95)
<i>Lathyrus silvester</i> L.	2001	60	5.07 – 25.08	2 (?)	2 614	52 - 69	15.1 - 31.6	23.31	61 (76)
	2002	70	16.06 – 10.08	3 (?)	2 029	54 - 68	19.7 - 39.3	26.93	55 (69)
	2003	80	22.06 – 12.08	3 (?)	1 768	33 - 51	19.8 - 40.3	28.21	50 (62)
<i>Trifolium incarnatum</i> L.	2002	35	21.06 – 15.07	42 (42)	26 675	37 - 64	1.1 - 7.2	4.03	108 (134)
	2003	40	10.07 – 3.08	63 (63)	43 120	18 - 33	1.1 - 3.5	2.22	96 (120)
	2004	60	2.07 – 3.08	166 (166)	47 098	46 - 68	1.3 - 4.0	2.82	133 (166)
<i>Sida hermaphroditis</i> Rusby	2002	300	24.06 – 20.08	4 (28)	8 960	24 - 68	11.4 - 33.7	18.13	162 (203)
	2003	240	1.07 – 25.08	4 (27)	7 479	57 - 65	25.7 - 42.4	35.78	267 (334)
	2004	250	8.07 – 5.09	4 (24)	6 960	33 - 65	23.8 - 57.1	36.19	252 (315)
<i>Eupatorium cannabinum</i> L.	2002	75	26.06 – 25.08	? (31)	323 310	17 - 68	0.3 - 0.9	0.38	123 (154)
	2003	100	11.07 – 15.08	? (56)	303 760	30 - 62	0.2 - 0.6	0.43	131 (163)
	2004	130	8.07 – 24.08	? (54)	324 140	27 - 61	0.2 - 0.6	0.45	146 (182)
<i>Silphium perfoliatum</i> L.	2002	300	28.06 – 25.08	4 (23)	74 060	41 - 52	2.2 - 7.7	4.51	334 (418)
	2003	250	26.06 – 22.08	4 (21)	66 990	52 - 60	4.2 - 6.9	5.94	398 (497)
	2004	270	8.07 – 10.09	4 (17)	82 331	36 - 61	4.9 - 9.2	7.55	622 (777)
<i>Echinacea purpurea</i> Moench	2002	65	2.07 – 10.08	6 (88)	21 278	45 - 67	2.0 - 5.0	3.18	68 (85)
	2003	70	9.07 – 20.08	6 (96)	32 760	38 - 68	2.7 - 12.4	6.31	207 (258)
	2004	80	16.07 – 2.09	6 (27)	32 875	43 - 63	3.0 - 8.7	5.54	182 (228)
<i>Dahlia variabilis</i> (Willd.) Desf.	2001	60	10.07 – 25.09	8 (17)	25 049	35 - 58	2.3 - 10.7	5.61	141 (176)
	2002	65	7.07 – 10.09	12 (18)	32 490	43 - 74	2.2 - 8.0	5.78	188 (235)
	2003	90	18.07 – 28.08	16 (16)	31 702	28 - 49	2.8 - 5.6	3.89	123 (154)
<i>Echinops ritro</i> L.	2002	125	13.07 – 15.08	4 (13)	7 295	32 - 57	30.3 - 55.6	39.74	290 (362)
	2003	120	20.07 – 22.08	4 (13)	7 091	49 - 62	23.8 - 67.5	47.52	337 (421)
	2004	130	23.07 – 1.09	3 (31)	9 243	61 - 73	41.8 - 69.2	54.62	505 (631)
<i>Echinops ruthenicus</i> Bieb.	2002	110	25.07 – 20.08	3 (12)	7 059	34 - 71	18.0 - 45.7	32.80	232 (289)
	2003	100	26.07 – 26.08	3 (16)	9 407	34 - 45	13.4 - 24.4	17.08	161 (201)
	2004	125	5.08 – 4.09	3 (23)	11 730	44 - 65	6.4 - 17.6	12.22	143 (179)

nectar and pollen and it is only on the flowers of *Sida* that bees with pollen loads were not seen. The plots visited by honeybees in the greatest numbers were those planted to *Echinops*, *Silphium*, *Sida*, *Dahlia* and *Onopordon*, lower numbers were seen on *Trifolium incarnatum*, *Lathyrus* and *Echinacea*, and the lowest on *Anthyllis* and *Eupatorium*.

## DISCUSSION

The overwhelming majority of the data presented in this paper have no counterparts in literature. The results from this study for *Sida* and *Silphium* are borne out by the data reported by Wróblewska (1986, 2000) on a high beekeeping value of those plants. Some of their flowers (especially those of *Silphium*) showed even better nectar secretion rate in Puławy than they did in Lublin, hence their honey output per 1 ha in the former location was 100% higher or more. In addition, it turned out that *Echinops ritro* in terms of honey output equals *Echinops commutatus* (Jabłoński 1992) investigated earlier in Puławy which cannot be said of *Echinops ruthenicus*.

When compared to the “queen of melliferous plants” (*Phacelia tanacetifolia*), which is widely known for its honey output from a dense stand to be ca. 300 kg per 1 ha, the honey output of *Silphium* and *Echinops ritro* was found to be at a higher level and that of *Sida*, *Echinops ruthenicus* and *Echinacea* to be similar. The outputs of *Trifolium incarnatum*, *Eupatorium*, *Dahlia* and *Onopordon* were slightly lower (100-200 kg/ha) and those of *Anthyllis* and *Lathyrus* were much lower (less than 100 kg/ha).

## CONCLUSIONS

Total amount of sugars secreted by 10 flowers were most of the time ca. 0.4 mg for *Eupatorium cannabinum*, 1-2 mg for

*Anthyllis vulneraria*, 2-3 mg for *Onopordon acanthium* and *Trifolium incarnatum*, 4-6 mg for *Dahlia variabilis*, *Echinacea purpurea* and *Silphium perfoliatum*, 20-30 mg for *Echinops ruthenicus*, *Lathyrus silvester* and *Sida hermaphroditis*, and 40 mg or more for *Echinops ritro*.

Amounts of sugars yielded over the blooming period as nectar from 1 ha of a dense stand were 50-60 kg for *Anthyllis* and *Lathyrus*, 90 kg for *Onopordon*, 110 kg for *Trifolium*, 130 kg for *Eupatorium*, 150 kg for *Dahlia* and *Echinacea*, 180(190) kg for *Echinops ruthenicus* and *Sida*, 380 kg for *Echinops ritro* and 450 kg for *Silphium*.

Flowers of the surveyed species were willingly visited from morning until evening, primarily by the honeybee but also by wild bee-like insects and *Diptera* interested in nectar and pollen.

In principle, all the species deserve beekeepers' attention as they enrich melliferous flora in the areas of their occurrence. Some of them (such as *Silphium*, *Echinops ritro*, *Sida*, or *Lathyrus*) are suitable to be introduced on idle lands to improve honey flows.

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## NEKTAROWANIE I WYDAJNOŚĆ MIODOWA ROŚLIN MIODODAJNYCH W WARUNKACH POLSKI – Część XV

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### S t r e s z c z e n i e

W latach 2000-2004 w Puławach badano wartość pszczelarską 11 gatunków roślin zielnych, które rosły na glebie biellicowej lekkiej, klasy IV i V.

Stwierdzono, że całkowite ilości cukrów wydzielane w nektarze przez 10 kwiatów *Eupatorium cannabinum* wynosiły około 0,4 mg, *Anthyllis vulneraria* 1-2 mg, *Onopordon acanthium* i *Trifolium incarnatum* 2-3 mg, *Dahlia variabilis*, *Echinacea purpurea* i *Silphium perfoliatum* 4-6 mg, *Echinops ruthenicus*, *Lathyrus silvester* i *Sida hermaphroditis* 20-30 mg, a *Echinops ritro* 40 mg i więcej. Ilości cukrów dostarczanych w nektarze w ciągu okresu kwitnienia roślin z 1 ha dobrze zwartego łąnu *Anthyllis* i *Lathyrus* wynosiły 50-60 kg, *Onopordon* 90 kg, *Trifolium* 110 kg, *Eupatorium* 130 kg, *Dahlia* i *Echinacea* 150 kg, *Echinops ruthenicus* i *Sida* 180(190) kg, *Echinops ritro* 380 kg, *Silphium* 450 kg. Kwiaty badanych roślin były chętnie odwiedzane od rana do wieczora przede wszystkim przez pszczołę miodną, a także przez dzikie pszczołowate oraz muchówki zainteresowane nektarem i pyłkiem.

W zasadzie wszystkie badane gatunki zasługują na uwagę pszczelarzy, ponieważ tam gdzie występują, przyczyniają się do wzbogacenia flory miododajnej. Niektóre z nich (jak *Silphium*, *Echinops ritro*, *Sida*, czy *Lathyrus*) dobrze nadają się do rozpowszechniania na nieużytkach w celu poprawy pożytków pszczelich.

**Słowa kluczowe:** rośliny miododajne, kwitnienie, nektarowanie, oblot przez pszczoły.