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THE EFFECT OF CULTIVATION METHOD ON THE GROWTH AND FLOWERING OF MEALY SAGE (*SALVIA FARINACEA* BENTH.)

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Summary. *Salvia farinacea* Benth. 'Blue Victory' was cultivated from seedlings and by sowing of seeds directly into the ground. Four sowing terms: March 15th–16th and 29th– 30th in a greenhouse (cultivation from seedlings) and April 20th–22nd and May 12th–14th (direct seeding to the ground) and three types of plant density: 16, 12 and 8 plants per m^2, were used. It was concluded that cultivation from seedlings was more beneficial than direct sowing because the plants start flowering earlier, are higher by approx. 20% and produce longer inflorescence stems and inflorescences. Both ways of cultivation ensures obtaining of flowering plants until the end of September. However, delay of sowing causes lower quality of plant evaluated by the number and length of inflorescence shoots, height and diameter of plants and fresh weight of the aboveground part. Cultivation density does not affect morphological traits and plants meets the requirements for flowerbed plant in all studied combinations.

Key words: annual plants, flowerbed plants, plant density, sowing term

INTRODUCTION

Salvia farinacea Benth. is a very valuable annual, flowering plant used in flowerbeds. It can also be cultivated for cut flowers and dry bouquets. It originates from Texas and New Mexico [Krause 1997, Nahed Abd El-Aziz, and Balbaa 2007, Barnes et al. 2012]. Its flowers are gathered into spikes. Corolla can be dark blue, azure, ivory white or white and grey. Purple inflorescence peduncles are covered with soft hairs which gives impression of powdery coating [Anella 2000, Krause et al. 2004, McKenney et al. 2008]. Research

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on the effect of the sowing term and cultivation density indicated that these agro-technical features can be decisive about ornamental value of decorative plants due to their effect on the growth of the plant, the number and size of inflorescence and plant diameter [Wraga and Zawadzińska 2003, Karczmarz and Laskowska 2004, Pogroszewska and Laskowska 2008]. Nonetheless, plant flowering can be affected by many other cultivation factors [Knowles et al. 1993, Chyliński and Łukaszewska 2008, Nowak and Kunka 2009, 2010]. The selected method of cultivation determines the time when plant reaches full ornamental value and length of flowering period. As a consequence it also determines their role and usage in green areas, including household gardens. Traditionally, to set up an urban flowerbed, ready seedlings of mealy sage are used, however for small household gardens direct sowing into the ground could be applied.

Aim of the research was to define the effect of sowing term and cultivation method as well as cultivation density of *S. farinacea* on its growth and flowering.

MATERIAL AND METHODS

Experiment conditions

The experiment was conducted on the plants of *Salvia farinacea* Benth. 'Blue Victory', at the Experimental Farm (Felin) of the University of Life Sciences in Lublin in three vegetation periods (2005, 2006, 2008). Plants were cultivated from seedlings and by sowing directly into the ground. Four sowing terms were used. In the first term seeds were sown on March 15th–16th and in the second on March 29th–30th , both in the greenhouse, in the third: on April 20th–22nd directly into the ground and in the fourth on May 12th–14th also directly into the ground.

Seeds of plants cultivated from seedlings were sown into pots with peaty substrate mixed with sand (3 : 1) enriched with Azofoska (0.2 g·dm^{-3} of medium). At first seedlings were cultivated at 20°C, and then temperature was lowered to 18°C. In the phase of 2–3 leaves seedlings were planted out into seedling trays (6 × 6 cm) with the same medium that was used to sow the seeds. The plants were treated three times with 0.1% Insol U. Seedlings were transplanted into the ground onto the fields sized 1.40 × 1.40 m, between May 19th and 23rd depending on the year of experiment. At that time they had 6–8 proper leaves and inflorescence bud of up to 5 cm of length. Seeds sowing into the ground was done onto the fields of the same surface area. The experiment was set up on brown soil of lessive type, on marlstone containing the average of 1.66% of humus in arable layer [Domżał and Pranagal 1995]. Content of available mineral elements was analyzed by Local Agrochemical Station in Lublin. In the three years of the research it was similar and equaled: N-NO_3 – 25.0–31.3; P – 133.0–137.0; K – 129.0–135.0; Mg – 52.0–69.0; Ca – 629.0–713.0 mg·dm^{-3} of soil, salinity – 0.30–0.48 g NaCl dm^{-3}, pH in H_2O – 6.23–6.54.

Three types of plant density were used as second factor of the experiment: 16 plants per m^2 (spacing 25 × 25 cm), 12 (30 × 30) and 8 (35 × 35). The experiment was set up in three replicates, where field served the role of repetition. In the field, seeds were sown point-wise, in a group of several seeds in the above mentioned spacing. After sprouting, seedlings were uprooted and only the strongest one was left. Plants from sowing in greenhouse were planted into soil also in the above mentioned spacing. The only agricultural practice was the weeding once per month. Start date of flowering for each plant was noted – one fully developed flower on the first flowering shoot. In the phase when half of flowers of that first shoot were developed, morphological traits were determined: plant height, plant diameter, inflorescence length, length of inflorescence shoot with the mealy part (measured from the last leaf to the top of inflorescence).

In the last decade of September the experiment was completed and fresh weight of aboveground part of plants as well as number of inflorescence shoots on every plant were evaluated. The course of plant flowering was evaluated by noting, in weekly intervals, number of shoots in phase when half of flowers in inflorescence were developed. Next, their percentage share in relation to their total number of flowering inflorescence shoots was determined.

Statistical methods

Test results were processed in analysis of variance. In order to evaluate the significance of differences between means, Tukey's test was used which calculated confidence semi-intervals at the level of significance $\alpha = 0.05$.

Meteorological conditions

During the time of research, thermal conditions and precipitation level in 2005, compared to many-year average, were not favorable to vegetation. Temperature was close to the many-year average but in April which is the month of sowing seeds, rainfall was below the many-year average. In the initial phase of growth, in June, there was the water shortage (Table 1). Average monthly temperature in particular months during vegetation period in 2006 was similar to the many-year average excluding September when temperature was significantly higher in comparison to the many-year average. Significant shortage of water was noted in July 2006. Average temperature of July was higher than many-year average for that month. July and September, which are the months of flowering of mealy sage, were among the warmest months. Also in August temperature was high. In 2008, in the third decade of April and in the second and third decade of May – dates of sowing seeds and planting seedlings – temperature was higher than many-year average temperature. In that month greater total sum of rainfall was noted. Similarly, in the other months, average monthly temperature was higher in comparison to many-year average, whereas September brought heavy rainfall (Table 1).

Table 1. Meteorological date after the measurements of the Experimental Meteorological Station of the University of Life Sciences in Lublin in cultivation period of *S. farinacea*.

Tabela 1. Dane meteorologiczne według pomiarów Stacji Meteorologicznej Uniwersytetu Przyrodniczego w Lublinie w okresie wegetacji *S. farinacea*

Year Rok	Months Miesiące	Temperature – Temperatura [°C]					Precipitation – Opady [mm]				
		Decade means Średnie dekadowe			Mean Średnia	Mean Średnia (W)	Decade sums Sumy dekadowe			Total Suma	Total Suma (W)
		I	II	III	(M)	1951–2005	I	II	III	(M)	1951–2005
2005	March – marzec	–4.4	1.0	2.9	–0.2	1.1	21.7	21.3	5.0	48.0	26.3
	April – kwiecień	9.0	10.9	7.4	9.1	7.4	0.2	4.0	14.4	18.6	40.2
	May – maj	10.8	10.5	18.0	13.1	13.0	32.8	65.0	0.2	98.0	57.7
	June – czerwiec	13.4	17.2	17.4	16.0	16.2	47.1	7.4	1.4	55.9	65.7
	July – lipiec	18.9	19.9	20.4	19.7	17.8	0.0	22.4	87.4	109.8	83.5
	August – sierpień	16.5	16.4	17.8	16.9	17.1	103.9	3.2	1.6	108.7	86.6
	September – – wrzesień	16.8	14.4	13.5	14.9	12.9	0.0	8.9	9.1	18.0	51.6
2006	March – marzec	–4.3	–1.9	2.7	–1.17	1.1	5.8	9.7	31.5	47.0	26.3
	April – kwiecień	6.2	7.7	12.3	8.7	7.4	19.4	10.5	0.4	30.3	40.2
	May – maj	13.5	14.6	12.8	13.6	13.0	9.0	18.4	32.1	57.9	57.7
	June – czerwiec	11.6	17.9	21.1	16.8	16.2	28.4	0.0	9.5	37.9	65.7
	July – lipiec	21.2	20.8	23.5	21.8	17.8	0	6.8	0.0	6.8	83.5
	August – sierpień	18.4	18.3	15.6	17.4	17.1	73	79.7	45.6	198.3	68.6
	September – – wrzesień	20.2	21.8	21.5	21.2	12.9	11.0	0.0	0.0	11.0	51.6
2008	March – marzec	3.4	3.4	3.4	3.4	1.1	16.6	27.0	20.2	64.8	26.3
	April – kwiecień	7.8	9.4	10.8	9.3	7.4	17.6	35.3	2.9	55.8	40.2
	May – maj	11.3	13.3	13.6	12.8	13.0	57.1	34.7	9.8	101.6	57.7
	June – czerwiec	18.0	16.4	18.8	17.7	16.2	0.0	19.6	6.3	25.9	65.7
	July – lipiec	17.1	18.9	18.9	18.3	17.8	39.6	19.3	18.2	77.1	83.5
	August – sierpień	19.9	20.7	17.3	19.3	17.1	11.4	7.0	26.6	45.0	68.6
	September – – wrzesień	19.3	8.3	10.2	12.6	12.6	21.6	45.3	35.3	102.2	51.6

M – monthly – miesięcznie; W – many years – wieloletnia.

RESULTS AND DISCUSSION

It was concluded that the period that passed between sowing seeds and the beginning of plant flowering depended on the term of sowing and equaled on the average between 95 and 116 days. Plants that bloomed the earliest, on June 19th, were those that were cultivated from seedling obtained from seeds sown in the first term. Plants that bloomed the latest, on July 23rd, came from seeds sown into the ground in the second term (Fig. 1). The plants bloomed until the first frosts appeared. Blooming period was shorter when date of sowing seeds was later, both in a greenhouse and in the field – plants that grew from seeds sown on March 15th bloomed on the average 85 days. Plants cultivated from a seedling obtained from seeds sown in the first term produced average 30.7 shoots, by 26.8% more than plants cultivated from sowing seeds directly into the ground in the first term and by 74.4% more than plants cultivated from sowing seeds in the second term (Table 2).

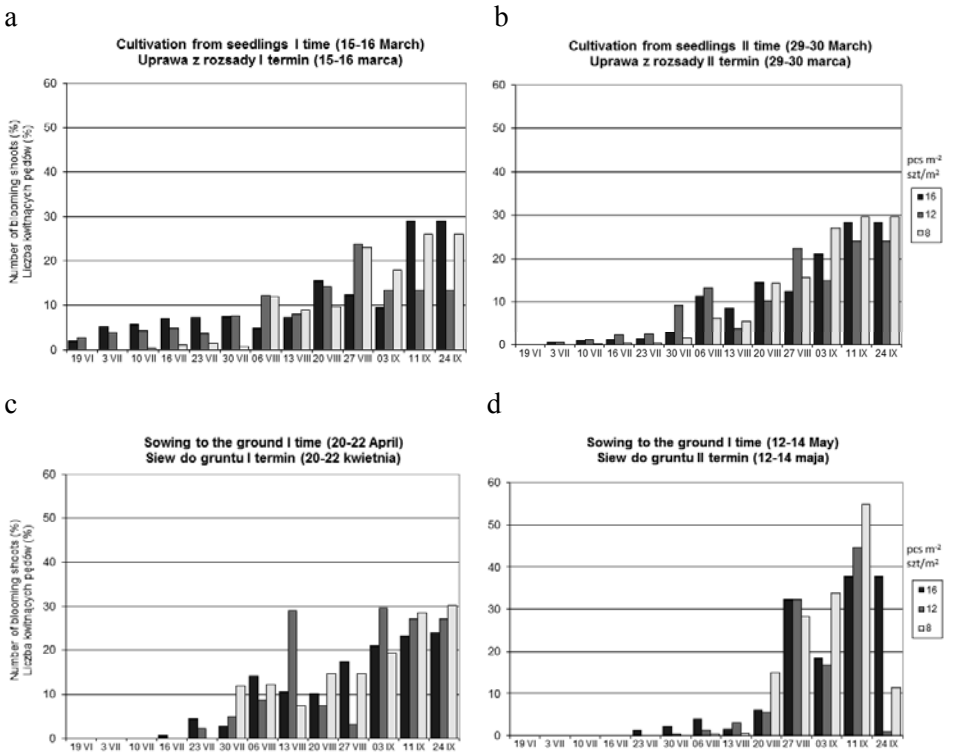

Fig. 1. The influence of sowing date and plant density on flowering of *S. farinacea* plants (2008)

Rys. 1. Wpływ terminu siewu i zagęszczenia roślin na przebieg kwitnienia *S. farinacea* (2008)

It was noted, that number of inflorescence shoots in the third year of research was significantly greater than number of inflorescence shoots in 2005 and 2006 (Table 2). In the last year of cultivation plants produced almost twice more inflorescence shoots compared to previous year. Influence of density on the value of the examined feature was not noted.

Comparison of number of inflorescence shoots produced by plants cultivated in different density in different years shows that in 2008 plants produced by approx. 36% more inflorescence shoots at density of 12 and 8 plants per m^2 than at density of 16 plants per m^2. Based on evaluation of the effect of sowing term and plant cultivation density it was concluded that most shoots were produced by plants cultivated from seedling of the first term of sowing, at every type of cultivation density (28.9–32.1 pcs). Sowing seeds directly to the ground in the last term led to the lowered number of shoots by over 40% at every cultivation density.

Plants cultivated from seedlings produced approx. 8–12% longer inflorescence shoots than shoots of plants cultivated from direct seeding (Table 2). Pogroszewska and Laskowska [2008] in their research on *Salvia horminum* also concluded that sowing seeds

Table 2. The influence of sowing date and plant density of *S. farinacea* plants on the number and morphological traits of inflorescence shoots

Tabela 2. Wpływ terminu wysiewu nasion i zagęszczenia roślin na liczbę i cechy morfologiczne pędów kwiatostanowych *S. farinacea*

Specification Wyszczególnienie		Number of inflorescence shoots per plant [pcs] – Liczba pędów kwiatostanowych na roślinie [szt.]															
		density [pcs·m^{-2}] – zagęszczenie [szt.·m^{-2}]												mean – średnia			
		16				12				8							
		2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia
Cultivation from seedlings Uprawa z rozsady	I date I termin	20,8 e-i	21,7 e-i	40,3 bc	28,9 AB	22,4 e-i	19,2 f-i	45,1 abc	31,2 A	20,8 e-i	23,3 e-h	47,4 ab	32,1 A	21,4 cd	26,7 bc	44,2 a	30,7 A
	II date II termin	23,1 e-h	25,6 efg	37,4 cd	26,7 ABC	19,6 f-i	26,2 efg	51,9 a	30,6 A	19,1 f-i	28,2 def	47,9 ab	30,6 A	20,6 cd	21,6 cd	45,7 a	29,3 AB
Sowing to the ground Siew do gruntu	I date I termin	21,5 e-i	19,8 f-i	29,6 de	22,0 ABC	19,8 f-i	20,2 e-i	37,4 cd	23,9 ABC	26,2 efg	24,8 efg	40,6 bc	26,7 ABC	22,5 cd	14,2 d	35,9 ab	24,2 B
	II date II termin	21,7 e-i	14,8 hij	6,3 j	16,2 C	19,2 f-i	14,6 hij	20,2 e-i	18,2 BC	23,3 e-h	13,4 ij	18,0 g-i	18,2 BC	21,4 cd	16,5 cd	14,8 d	17,6 C
Mean – Średnia		21,8bc	20,2bc	28,4b	23,5A	20,3bc	19,0c	38,7a	26,0A	22,4bc	19,9bc	38,5a	26,9A	21,5b	19,7b	35,2a	25,4
×		Length of inflorescence shoots – Długość pędu kwiatostanowego [cm]															
		density [pcs·m^{-2}] – zagęszczenie [szt.·m^{-2}]												mean – średnia			
		16				12				8							
		2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia
Cultivation from seedlings Uprawa z rozsady	I date I termin	26,8 f	39,3 ab	14,0 ghi	26,7 AB	26,4 f	39,3 ab	14,8 gh	26,8 AB	26,4 f	38,8 ab	12,4 ghi	25,9 ABC	26,5 d	39,1 a	13,7 e	26,5 A
	II date II termin	25,0 f	35,0 cd	14,3 ghi	24,8 ABC	25,4 f	36,8 bc	14,0 ghi	25,4 ABC	26,5 f	41,0 A	14,6 gh	27,4 A	25,6 d	37,6 ab	14,3 e	25,8 A
Sowing to the ground siew do gruntu	I date I termin	24,1f	33,7 cde	12,9 ghi	23,6 C	25,4 f	31,1 e	15,0 g	23,9 BC	24,6 f	33,9 cde	11,7 hi	23,4 C	24,7 d	32,9 c	13,2 e	23,6 B
	II date II termin	23,7 k	34,5 cd	14,9 gh	24,4 ABC	25,6 f	35,3 cd	11,2 i	24,0 BC	24,7 bc	33,3 de	12,3 ghi	23,4 C	24,7 d	34,3 bc	12,8 e	23,9 B
Mean – Średnia		24,9b	35,6a	14,0c	24,8A	25,7b	35,6a	13,8c	25,0A	25,5b	36,7a	12,7c	25,0A	25,4b	36,0a	13,5c	25,0
×		Length of inflorescence – Długość kwiatostanu [cm]															
		density [pcs·m^{-2}] – zagęszczenie [szt.·m^{-2}]												mean – średnia			
		16				12				8							
		2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia
Cultivation from seedlings Uprawa z rozsady	I date I termin	18,6 a-g	22,3 ab	12,0 j-l	17,6 A	15,9 g-i	22,6 a	13,3 i-k	17,3 AB	16,8 e-i	21,7 abc	14,2 h-k	17,5 AB	17,1 cd	22,2 a	13,2 cd	17,5 A
	II date II termin	17,5 d-h	19,5 a-g	12,1 j-l	16,4 AB	16,3 f-i	20,0 a-f	11,0 klm	15,7 AB	20,4 a-e	16,8 e-i	11,3 klm	16,1 AB	18,1ab	18,7ab	11,4de	16,1 AB
Sowing to the ground Siew do gruntu	I date I termin	17,0 d-i	17,1 d-i	8,6 lm	14,2 B	16,7 e-i	19,0 a-g	7,8 m	14,5 AB	19,0 a-g	18,3 b-g	7,7 m	15,0 AB	17,6 abc	18,1 ab	8,0 e	14,6 B
	II date II termin	18,0 c-h	21,0 a-d	11,2 klm	16,7 AB	18,2 AB	19,4 a-g	8,7 lm	15,4 AB	18,0 c-h	15,6 g-j	10,5 klm	14,7 AB	18,0 abc	18,6 ab	10,1 de	15,6 AB
Mean – Średnia		17,8a	19,9a	11,0b	16,2A	16,8a	20,2a	10,2b	15,7A	18,5a	18,1a	10,9b	15,8A	17,7a	19,4a	10,7b	15,9

The means marked with the same letter are not differ in significant way/Wartości oznaczone tą samą literą nie różnią się istotnie.

directly into the ground resulted in production of shorter shoots. In this research, the longest inflorescence shoots were noted in plants in their second year of cultivation (36 cm) – Table 2. They were almost three times longer than shoots from 2008, when shoots were most numerous. The length of inflorescence shoots in 2006 might have been significantly influenced by favorable weather conditions during vegetation. Similarly, Blanchard and Runkle [2011] concluded that plants flowered better in high temperature, and that temperature of 28°C is optimal for *S. farinacea* flowering. In the third year of the research the shortest inflorescence shoots were noted, which was certainly influenced by climate factors. Evaluation of the effect of sowing term and plant cultivation density led to conclusion that plants produced the longest shoots when they were cultivated from a seedling obtained from seeds sown in the second term and cultivated in density of 8 plants per m^2 (27.4 cm). It was observed particularly in 2006 (41 cm). Influence of cultivation density on the length of inflorescence shoot was not noted, which is compliant with the results of research by Karczmarz and Laskowska [2003a] on the effect of cultivation method and density on morphological features of *Lonas annua*.

Not only length of the entire inflorescence shoot decides about decorative value of flower bed plants, but also length of the inflorescence. Inflorescences of plants cultivated from a seedling obtained from seeds sown in a greenhouse in the first term were the longest, and by 19.9% longer than inflorescence of plants obtained from direct seeding into the ground in the first term (Table 2). Plant density did not affect the inflorescence length (Table 3). Pogroszewska and Laskowska [2008] and Karczmarz and Laskowska [2003b] did not note any effect of plant density on the quality of inflorescence of *Salvia horminum* and *Lonas annua*, respectively.

The sowing term of mealy sage seeds significantly influenced other morphological traits of plants. Cultivation from a seedling obtained from sowing seeds in the middle and end of March in a greenhouse, led to production of plants that grew the strongest in the ground, which however does not confirm research results of Jadczak [2001] who cultivated *Salvia officinalis* L. from a seedling and obtained the lowest plants. Sowing seeds into the ground in the latest term resulted in the lowest plants (56 cm) – Table 3.

The favorable effect of weather conditions on the height of plants was noted in 2006. The highest plants were obtained regardless of the term of seeds sowing and plant density (Table 3). The influence of plant density on plant height was not observed. Comparison of the height of plants depending on density in different years shows that the highest plants were cultivated from seedlings at every planting density (from 64.9 to 70.2 cm).

Cultivation method had significant influence on the diameter of plants. Plants obtained from seedlings were characterized by significantly greater diameter, by 16.4–35.7% greater (depending on the sowing term) than plants cultivated from direct seeding into the ground. Plant cultivation in variable density did not significantly affect diameter of plants (Table 3). Evaluation of the effect of sowing term and plant cultivation density leads to conclusion that plants cultivated from a seedling in density of 12 plants per m^2 (55.9 and 53.7 cm) were characterized by the greatest diameter, unlike plants obtained from direct seeding. The smallest diameter (approx. 36 cm) was noted in plants cultivated from direct seeding into the ground in the last term at density of 16 and 8 plants per m^2.

Table 3. The influence of sowing date and plant density of *S. farinacea* plants on their morphological traits

Tabela 3. Wpływ terminu wysiewu nasion i zagęszczenia roślin *S. farinacea* na ich cechy morfologiczne

Specification Wyszczególnienie		Hight of plants – wysokość roślin [cm]															
		density [pcs·m^{-2}] – zagęszczenie [szt.·m^{-2}]												mean – średnia			
		16				12				8							
		2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia
Cultivation from seedlings Uprawa z rozsady	I date I termin	57,4 h-k	82,8 a	66,2 f-g	68,8 A	53,2 i-m	75,3 bcd	68,5 ef	65,7 AB	49,5 lm	74,9 b-e	73,2 b-e	65,9 AB	53,3 cd	77,7 a	69,3 b	66,7 A
	II date II termin	51,8 j-m	72,9 b-e	70,2 c-f	64,9 AB	58,9 hi	74,8 b-e	76,8 abc	70,2 A	54,6 i-l	78,0 ab	74,8 b-e	69,1 A	55,0 cd	75,2 ab	73,9 ab	68,0 A
Sowing to the ground Siew do gruntu	I date I termin	51,8 j-m	70,4 c-f	57,8 hij	60,0 BC	50,4 lm	68,6 ef	61,5 g-h	60,2 BC	49,5 lm	69,1 def	59,2 h-i	59,3 BC	50,5 d	69,3 b	59,5 c	59,8 B
	II date II termin	54,9 h-l	77,6 ab	36,2 n	56,3 CD	47,8 m	70,2 c-f	50,1 lm	56,0 CD	47,0 m	69,2 def	50,8 klm	50,9 D	49,9 d	72,3 ab	45,7 d	56,0 C
Mean – Średnia		53,9cd	75,9a	57,6bc	62,5A	52,5cd	72,2a	64,2b	63,0A	50,1d	72,7a	64,5b	62,4A	52,2B	73,6A	62,1C	62,6
×		Diameter of plants – średnica roślin [cm]															
		density [pcs·m^{-2}] – zagęszczenie [szt.·m^{-2}]												mean – średnia			
		16				12				8							
		2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia
Cultivation from seedlings Uprawa z rozsady	I date I termin	42,8 g-l	53,6 b-e	56,1 ab	50,8 AB	42,6 h-l	55,2 abc	54,8 bc	55,9 A	41,2 i-m	55,0 bc	52,0 b-f	49,4 AB	42,2 cd	54,6 a	54,3 a	50,3 A
	II date II termin	43,9 f-k	46,4 d-j	51,5 b-f	47,2 ABC	42,7 g-l	55,2 abc	63,3 a	53,7 A	42,0 h-m	56,8 ab	54,0 bcd	51,0 AB	42,9 cd	52,8 ab	56,3 a	50,6 A
Sowing to the ground Siew do gruntu	I date I termin	39,2 j-n	47,6 c-i	41,0 i-m	42,6 BCD	36,0 k-n	49,4 b-h	45,8 e-j	43,7 BCD	41,0 i-m	45,7 eij	43,1 g-l	43,2 BCD	38,7 cde	47,6 abc	43,3 bcd	43,2 B
	II date I termin	35,4 l-n	50,8 b-g	23,2 o	36,5 D	34,4 mn	47,8 c-i	35,2 l-n	39,1 CD	31,7 n	42,6 h-l	34,8 l-n	36,3 D	33,8 de	47,0 abc	31,0 e	37,3 C
Mean – Średnia		40,3cd	49,6ab	42,9bcd	44,3A	38,9d	51,9a	49,8ab	46,8A	39,0cd	50,0ab	46,0abc	45,0A	39,4c	50,5a	46,2b	45,4
×		Fresh weight of the aboveground part [g·plant^{-1}] – świeża masa części nadziemnej [g·roślina^{-1}]															
		density [pcs·m^{-2}] – zagęszczenie [szt.·m^{-2}]												mean – średnia			
		16				12				8							
		2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia	2005	2006	2008	mean średnia
Cultivation from seedlings Uprawa z rozsady	I date I termin	630,0 b-f	747,3 b	244,1 l-o	547,1 ABC	640,0 b-f	661,3 b-e	304,7 jkl	535,3 ABC	595,3 c-f	929,3 a	253,6 lmn	592,7 A	621,7 ab	786,0 a	267,5 c	558,4 A
	II date II termin	602,0 c-f	664,6 b-e	285,5 klm	517,4 ABC	626,0 b-f	714,6 bc	395,0 ijk	566,5 AB	686,0 bcd	895,3 a	308,3 jkl	629,9 A	638,0 ab	758,2 a	317,6 c	571,2 A
Sowing to the ground Siew do gruntu	I date I termin	562,6 d-h	506,6 f-i	156,5 m-p	408,6 BC	622,6 b-f	570,6 d-g	210,1 l-o	467,8 ABC	438,0 g-j	614,7 b-f	218,8 l-o	423,8 BC	541,1 b	564,0 b	195,1 cd	443,4 B
	II date II termin	557,3 d-h	641,3 b-f	46,5 p	415,0 BCD	556,0 d-h	596,0 c-f	119,9 n-p	423,9 BC	430,6 h-j	538,0 e-h	109,8 op	392,8 C	548,0 b	591,7 b	92,1 d	410,6 B
Mean – Średnia		588,0b	645,0 ab	183,1c	472,0A	611,1ab	635,6 ab	248,4c	498,4A	562,5 b	744,3a	222,6c	509,8A	287,2b	675,0a	218,1c	493,4

The means marked with the same letter are not differ in significant way/Wartości oznaczone tą samą literą nie różnią się istotnie.

Fresh weight of the aboveground part depended to a large extent on the sowing term and cultivation method. Plants cultivated from a seedling produced greater fresh weight than plants cultivated from direct seeding (Table 3). It was caused by greater tillering, and therefore production of greater amount of inflorescence shoots (Table 2). The greatest fresh weight was noted in 2006 in plants cultivated from a seedling sown in the first term (786 g). Plant density did not have significant effect on the fresh weight of plants.

CONCLUSIONS

1. Cultivation of mealy sage 'Blue Victory' from a seedling is more beneficial than cultivation from direct seeding into the ground because the plants start flowering earlier, are higher by approx. 20%, produce longer inflorescence shoots and longer inflorescences.

2. Plants cultivated from seedlings (sowing of seeds in the first and second date in greenhouse) ensures the earliest and long-term blooming, although satisfying results were obtained also in the case of plants cultivated from direct sowing into the ground. However, delay of sowing leads to lower quality of plants.

3. Cultivation density does not affect morphological traits. Mealy sage meets requirements for a flowerbed plant if it is cultivated from a seedling in density of 8–16 plants per m^2.

REFERENCES

Anella L.B., 2000. *Salvia*: an old standy and promising newcomer. Hort. Technology 10 (4), 800-805.

Barnes J., Whipker B., McCall I., Frantz J., 2012. Nutrient Disorders of 'Evolution' Mealy-cup Sage. HortScience 22(4), 502-508.

Blanchard M.T., Runkle E.S., 2011. Quantifying the thermal flowering rates of eighteen species of annual bedding plants. Sci. Hort. 128, 30-37.

Chyliński K.W., Łukaszewska A., 2008. Reaction of bedding ornamentals to drought stress. Ann. Warsaw Univ. of Life Sci. – SGGW, Horticult. and Landsc. Architect. 29, 39-44.

Domżał H., Pranagal J., 1995. Pedological characteristics of a research site for studing climate of the cultivated field. Zesz. Probl. Post. Nauk Roln. 419, 9-14.

Jadczak D., 2001. Wpływ sposobu produkcji rozsady na wielkość i jakość plonu liści szałwii lekarskiej. Ann. Univ. Mariae Curie-Skłodowska, sect. EEE T 9, 57-62.

Karczmarz K., Laskowska H., 2003a. Badania nad optymalnym terminem i zagęszczeniem siewu nasion lonasa rocznego (*Lonas annua* (L.) Vines et Druce) bezpośrednio do gruntu w uprawie na suche bukiety. Acta Sci. Pol. Hort. Cult. 2(2), 145-151.

Karczmarz K., Laskowska H., 2003b. Efektywność różnych metod uprawy i zagęszczeń roślin lonasa rocznego (*Lonas annua* (L.) Vines et Druce) przeznaczonego do zasuszania. Zesz. Probl. Post. Nauk Roln. 491, 151-159.

Karczmarz K., Laskowska H., 2004. Kwitnienie i jakość kwiatostanów lonasa rocznego (*Lonas annua* (L.) Vines et Druce) w zależności od sposobu uprawy. Acta Sci. Pol. Hort. Cult. 3(2), 85-92.

Knowles T.L., Hipp B.W., Hegemann M.N.,1993. Container medium and slow-release nitrogen fertilizer influence growth and quality of *Salvia farinacea*. HortScience 28(6), 623-625.
Krause J., 1997. Nowe rośliny kwietnikowe. Zesz. Probl. Post. Nauk Roln. 449, 107-115.
Krause J., Lisiecka A., Szczepaniak S., 2004. Ozdobne rośliny jednoroczne i dwuletnie. Wyd. Akad. Roln. im. Augusta Cieszkowskiego, Poznań, 70-73.
McKenney C.B., Balch S., Hegemann V., Metz S.P., 2008. 'Raider Azure' Mealy Blue Sage (*Salvia farinacea* var. *farinacea* Benth.). HortScience 43(2), 540-541.
Nahed Abd El-Aziz G., Balbaa L.K., 2007. Influence of tyrosine and zinc on growth, flowering and chemical constituents of *Salvia farinacea* plants. J. Appl. Sci. Res. 3(11), 1479-1489.
Nowak J., Kunka M., 2009. The effect of salinity, mycorrhizal inoculation and compost supply on growth and flowering of mealycup sage 'Blue Victory' (*Salvia farinacea* Benth). Zesz. Probl. Post. Nauk Roln. 539, 551-559.
Nowak J., Kunka M., 2010. Effect of Eco-compost supply and mycorrhizal inoculation on growth and flowering of *Salvia farinacea* Benth. 'Victory Blue' cultivated in heavy metal contaminated substrate. Zesz. Probl. Post. Nauk Roln. 551, 197-202.
Pogroszewska E., Laskowska H., 2008. The influence of cultivation method on the flowering of *Salvia horminum* L. 'Oxford Blue'. Acta Agrob. 61(1), 159-166.
Wraga K., Zawadzińska A., 2003. Wpływ terminu siewu nasion na kwitnienie kraspedii kulistej (*Craspedia globosa* Benth.). Ann. Univ. Mariae Curie-Skłodowska, sect. EEE, 13, 181-187.

WPŁYW SPOSOBU UPRAWY NA WZROST I KWITNIENIE SZAŁWII OMĄCZONEJ (*SALVIA FARINACEA* BENTH.)

Streszczenie. Szałwię omączoną (*Salvia farinacea* Benth.) 'Blue Victory' uprawiano z rozsady i siewu nasion bezpośrednio do gruntu. Zastosowano cztery terminy siewu: 15–16 i 29–30 marca w szklarni (uprawa z rozsady), 20–22 kwietnia i 12–14 maja (siew nasion wprost do gruntu) oraz trzy zagęszczenia roślin: 16, 12 i 8 roślin na m^2. Stwierdzono, że uprawa z rozsady jest korzystniejsza w porównaniu do uprawy z siewu nasion wprost do gruntu, ponieważ rośliny wcześniej wchodzą w kwitnienie, są wyższe o około 20%, wytwarzają dłuższe pędy kwiatostanowe i dłuższe kwiatostany. Oba sposoby uprawy zapewniają uzyskanie kwitnących roślin do końca września, jednak opóźnienie siewu nasion powoduje obniżenie jakości roślin ocenianej liczbą i długością pędów kwiatostanowych, wysokością i średnicą roślin oraz świeżą masą części nadziemnej. Gęstość uprawy nie ma wpływu na cechy morfologiczne, a rośliny spełniają wymagania rośliny rabatowej we wszystkich badanych kombinacjach.

Słowa kluczowe: rośliny jednoroczne, rośliny rabatowe, gęstość uprawy, termin siewu