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THE INFLUENCE OF CULTIVATION METHOD ON THE FLOWERING OF *SALVIA HORMINUM* L. 'OXFORD BLUE'

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S u m m a r y

Salvia horminum L.) 'Oxford Blue' was grown from transplants or it was direct seeded. Four sowing dates were applied: 15 March or 30 March – in a greenhouse, in order to obtain transplants, 13 April, 27 April and 11 May – sown directly into the ground. Three plant densities were applied: 25 plants×m^2, 16 plants×m^2, 12 plants×m^2. It was found that *Horminum* sage can be grown from transplants or direct seeded. The cultivation from transplants is more advantageous due to the earlier flowering of plants, by about two weeks, and a better quality of inflorescences evaluated in terms of their length and size of bracteoles. Direct sowing of *Horminum* sage at two-week intervals from the 2nd decade of April till the 2nd decade of May ensures that by the end of August mature inflorescence stems are obtained, ready for cutting. A delay in the date of sowing results in the development of significantly shorter inflorescence stems, irrespective of the plant density. Plant density does not affect significantly the length of the period of inflorescence formation and the date of flowering, but a larger spacing is favourable to plants growing big, what results in a larger fresh weight of the above-ground portion. Sage grown from transplants responses to favourable climatic conditions by the development of bigger inflorescences.

Key words: *Salvia horminum*, flowering, cultivation method, plant density

INTRODUCTION

Salvia horminum L. (*S. viridis* L., *S. viridis* var. *horminum* /L/. Batt. & Tr.) – (charming, green, erect) – is a border plant species, not very common in our country. In wild state, it is found in the Mediterranean Sea region. It is partly frost-resistant. In Poland it is grown as an annual plant. It flowers throughout the whole summer, producing unusually ornamental, coloured bracteoles clustered in the upper part of rigid, erect, branched stems. Bracteoles are white or, depending on the variety, violet, red-violet, pink, pink-purple, violet-blue, purple-blue, blue. *Horminum* sage, planted in large groups, creates a strong colour accent in a flower bed. It is perfectly suitable for cut flowers and for drying (N o w a k , 2002; K r a u s e et al. 2004). The sowing date and the spacing at which plants grow affect the flowering pattern and morphological traits of annual plants, thereby the ornamental effect in a flower bed as well as the time of harvest maturity of inflorescence stems intended for cut flowers and for drying (K r a u s e , 1997; B u r d a , 2000; L a s k o w s k a and K a r c z m a r z , 2000; K a r c z m a r z and L a s k o w s k a , 2003a, 2003b; P u c z e l and W a ź b i ń s k a , 2003; W r a g a and Z a w a d z i ń s k a , 2003; K a r c z m a r z and L a s k o w s k a , 2004). The aim of the study was to determine the influence of the date of sowing *Salvia horminum* L. seeds and the place of sowing: in a greenhouse or in the field, as well as the influence of plant density on its flowering.

MATERIALS AND METHODS

The experiment was conducted in the years 2004 and 2005 on plants of *Salvia horminum* L. 'Oxford Blue'. Sage seeds were sown in a greenhouse – in order to obtain transplants, or directly into the ground. 4 sowing dates were applied – the first one on 15 March in 2004 and on 30 March in 2005 – in the greenhouse in boxes with peat substrate mixed with sand at a 3:1 ratio, enriched with Azofoska (0.2 g per×dm^3 of substrate). At the 2-3 leaf stage, seedlings were transplanted into plug trays (6 cm x 6 cm) into the same substrate which was used for sowing. On 17 May in 2004, and on 21 May in 2005, the transplants were planted into the ground on plots with the dimensions of 1.40 m x 1.40 m. The second, third and fourth dates were dates of sowing directly into the ground (on the same plots) on, respectively: 13 April, 27 April and 11 May. The second factor in the experiment was 3 plant densities: 25 plants×m^2 (20 cm x 20 cm spacing), 16 plants×m^2 (20 cm x 30 cm spacing),

12 plants×m^2 (25cm x 35cm spacing). The experiment was to be carried out in three replicates, with the plot being a replicate. In the field, several seeds were sown into each hole at the a.m. spacing, and after emergence the seedlings were thinned, leaving the strongest one. The date of the start of flowering of the plants was noted – 3 coloured upper bracteoles on the first flowering stem – and the date of commercial maturity (a half of bracteoles coloured), and based on that, the length of the period from sowing to the start of flowering and the date of commercial maturity of the first flowering stem were determined. The first 10 flowering plants on the plot were taken into account. At the commercial maturity stage, morphological traits of inflorescence stems were determined. The height of the inflorescence stem, the length of the coloured inflorescence and the diameter of the bracteole were determined. In the last decade of September, the experiment was terminated, estimating the fresh weight of the above-ground portion of the plants. The study results were analyzed statistically by means of variance analysis. In evaluating the significance of differences between the means, Tukey's test was used, calculating confidence half-intervals at the level of significance of P=0.05.

Soil conditions

The experiment was carried out on grey-brown podzolic soil from loess-like deposits containing, on the average, 1.66% of humus in the arable layer. The average content of available nutrients, calculated based on results of the Chemical and Agricultural Station in Lublin, is presented in Tab. 1. It was similar in both years.

Meteorological conditions

Thermal and soil moisture conditions in 2004 were less favourable to the vegetation of sage plants than in 2005. In the period after planting the transplants in May, June and July 2004, average monthly temperature was lower than long-term average temperature (Tab. 2). In May and June, in the period of initial growth of the direct-seeded plants, there was also a shortage of rainfall. It was only in July that the monthly rainfall total was higher than the long-term average. In August there was high temperature with lower rainfall, compared to long-term values. In 2005, before planting the transplants, there was significant rainfall positively affecting soil moisture. In the 3rd decade of May, in the initial period after planting the transplants, temperature maintained at a high level. The warmest month was July – monthly average temperature was higher than long-term temperature by 1.5^{o}C. In the 3rd decade of July and in the 1st decade of August, intensive rainfall occurred. In the remaining period, rainfall was much smaller.

RESULTS AND DISCUSSION

Based on the conducted study, it was found that the period from sowing to the stage of commercial maturity of *Horminum* sage stems is relatively short – it is from about 10 up to about 17 weeks. A short growing period, as reported by N o w a k (2002), allows the time of flowering to be adapted to the needs of a producer specialising in the cultivation of plants for cut flowers and for drying. Sage sown at different dates was characterised by significant variations in the length of the period of inflorescence formation and the related start date of flowering of the plants, as well as the date when inflorescence stems reach the commercial maturity stage (Tab. 3). When analyzing the two-year average of the length of the period of inflorescence formation, it was observed that the later seeds were sown, the shorter the period of inflorescence development was, which indicates a significant participation of environmental factors (in addition to internal genetically controlled factors) in regulating the transition of plants from the vegetative to generative stage (K o p c e w i c z and L e w a k, 2002). This correlation manifested itself more clearly in the first year of observation, confirming results obtained by P u c z e l and W a ź b i ń s k a (2003) in their study on *Craspedia globosa*. The period of inflorescence development in the plants produced from transplants obtained from the earliest date of sowing – in the greenhouse – was the longest, but the plants produced using this method flowered first (Tab. 3). Sowing seeds of annual plants into boxes in a greenhouse is a proven method of obtaining earlier flowering of species sensitive to low temperature (C h m i e l, 2000). In the first year of study, when seeds

Table 1
Content of nutrients in soil at the end of plant vegetation.

pH (in H_2O)	Salinity (g NaCl×dm^{-3})	Nutrients (mg×dm^{-3} of soil)					Organic substance (%)
		$N\text{-}NO_3$	P	K	Mg	Ca	
6.6	0.16	31.5	140.5	210.0	98.0	598.2	1.66

Table 2
Meteorological data according to measurements of the Felin Meteorological Station of the Agricultural University in the sage vegetation period in the study years 2004-2005.

Months	Temperature in°C					Rainfall in mm				
	Decade means			Mean M	Mean W 1951-2000	Decade totals			Total M	Total W 1951-2000
	I	II	III			I	II	III		
2004										
March	-3.4	5.6	6.0	2.8	1.0	17.7	4.2	12.0	33.9	25.8
April	5.2	8.8	9.8	7.9	7.5	24.6	10.4	3.1	38.1	40.6
May	13.6	10.8	11.4	11.9	13.1	10.1	11.3	16.6	38.0	57.2
June	15.7	15.8	16.1	15.8	17.0	3.7	25.9	20.3	49.9	65.9
July	17.1	17.3	20.0	18.1	18.2	4.7	27.5	58.3	90.5	73.6
August	19.0	19.2	17.0	18.3	17.2	14.7	9.1	24.7	48.5	71.1
September	14.0	14.3	10.4	12.8	13.1	1.2	0.4	12.6	14.2	51.4
2005										
March	-4.4	1.0	2.9	-0.2	1.0	21.7	21.3	5.0	48.0	25.8
April	9.0	10.9	7.4	9.1	7.5	0.2	4.0	14.4	18.6	40.6
May	10.8	10.5	18.0	13.1	13.1	32.8	65.0	0.2	98.0	57.2
June	13.4	17.2	17.4	16.0	17.0	47.1	7.4	1.4	55.9	65.9
July	18.9	19.9	20.4	19.7	18.2	0.0	22.4	87.4	109.8	73.6
August	16.5	16.4	17.8	16.9	17.2	103.9	3.2	1.6	108.7	71.1
September	16.8	14.4	13.5	14.9	13.1	0.0	8.9	9.1	18.0	51.4

M – for months W – for years

in the greenhouse were sown 2 weeks earlier compared to the second year, the first flowering inflorescences were obtained on 9 June. In the second year – 19 June, respectively, by about 12 and 17 days earlier compared to the plants obtained from the earliest (13 April) sowing directly into the ground. The flowering of sage plants grown from transplants already in the first decade of June – 86 days after sowing – confirms a positive opinion of N o w a k (2002) relating to the suitability of this species for its use in flower beds, where it is important to obtain quickly the ornamental effect. The increasingly later sowing into the ground resulted in increasingly later flowering of the plants: a two-week delay in sowing resulted in a 11 – and 5-day shift of flowering of the plants in the first year, and a 3- and 13-day shift in the second year of study. The delay in sowing seeds of annuals by 3-4 weeks in relation to the date recommended by plant growers is justified by the purpose of obtaining the longest flowering of plants, even until autumn ground frosts (K r a u s e , 1997).

Differences between the average lengths of the period of inflorescence development, resulting from different plant densities, were mostly insignificant (Tab. 3).

Table 3
The influence of sowing date and plant density on the formation of the first flowering inflorescence stem of *Salvia horminum*.

Sowing date	Plant density (pcs×m^{-2})	Period from sowing to the beginning of plant flowering (days)			Period from sowing to commercial maturity of the inflorescence stem (days)			Average date of the beginning of plant flowering		Average date of commercial maturity of the inflorescence stem	
		2004	2005	Mean	2004	2005	Mean	2004	2005	2004	2005
2004.03.15 2005.03.30	25	86.7a	80.6cd	83.7a	102.9c	118.7a	110.8a	10.06.	19.06.	26.06.	27.07.
	16	86.4ab	80.2d	83.3a	102.7c	118.1a	110.4a	09.06.	18.06.	26.06.	26.07.
	12	86.0ab	83.0bcd	84.5a	102.3c	118.3a	110.3a	09.06.	21.06.	25.06.	26.07.
Mean		**86.4A**	**81.2B**	**83.8A**	**102.6C**	**118.4A**	**110.5A**	**09.06.**	**19.06.**	**26.06.**	**26.07.**
13.04.	25	70.8e	83.9abc	77.4b	86.7d	119.3a	103.0b	22.06.	05.07.	08.07.	10.08.
	16	70.5e	85.0ab	77.8b	86.8d	118.0a	102.4b	22.06.	06.07.	08.07.	09.08.
	12	70.2e	84.3ab	77.3b	86.5d	120.2a	103.4b	21.06.	06.07.	08.07.	11.08.
Mean		**70.5C**	**84.4AB**	**77.5B**	**86.7D**	**119.1A**	**102.9B**	**22.06.**	**06.07.**	**08.07.**	**10.08.**
27.04.	25	66.7f	72.6e	69.7c	85.0d	109.3b	97.2c	03.07.	09.07.	21.07.	14.08.
	16	66.4f	72.8e	69.6c	84.8d	110.0b	97.4c	03.07.	09.07.	21.07.	15.08.
	12	66.5f	73.2e	69.9c	84.3d	109.0b	96.7c	03.07.	09.07.	20.07.	14.08.
Mean		**66.6D**	**72.8C**	**69.7C**	**84.7D**	**109.4B**	**97.1C**	**03.07.**	**09.07.**	**21.07.**	**14.08.**
11.05.	25	59.5g	70.3e	64.9d	73.6e	107.3b	90.5d	10.07.	20.07.	24.07.	26.08.
	16	55.2h	71.4e	63.3d	74.2e	106.7b	90.4d	06.07.	21.07.	24.07.	26.08.
	12	55.0h	73.5e	64.3d	74.0e	110.2b	92.1d	05.07.	23.07.	24.07.	29.08.
Mean		**57.2E**	**71.8C**	**64.5D**	**73.9E**	**108.1B**	**91.0D**	**08.07.**	**22.07.**	**24.07.**	**27.08.**

Means marked with the same letter do not differ significantly at α=0.05 level of probability

Table 4
The influence of sowing date and plant density of *Salvia horminum* plants on their morphological traits.

Sowing date	Plant density (pcs×m^{-2})	Height of inflorescence stem (cm)			Length of coloured inflorescence (cm)			Diameter of bracteole (cm)			Fresh weight of the above-ground portion (g)		
		2004	2005	Mean	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean
2004.03.15 2005.03.30	25	59.0k	67.4 j	63.2e	9.9b-h	14.4a	12.2ab	2.6bcd	2.8ab	2.7ab	499.5ij	504.6hij	502.0de
	16	55.1kl	67.3j	61.2ef	10.2b-g	15.1a	12.7a	2.6bcd	2.9a	2.8a	659.6de	744.1bc	701.9b
	12	50.8l	66.8j	58.8f	10.3b-g	16.0a	13.2a	2.7abc	2.9a	2.8a	877.2a	934.5a	905.9a
Mean		**56.0E**	**67.2D**	**61.6C**	**10.1BC**	**15.2A**	**12.7A**	**2.6B**	**2.9A**	**2.8A**	**678.8A**	**727.7A**	**703.3A**
13.04.	25	87.7a	81.4b	84.6a	9.0e-h	10.6b-e	9.8cd	2.6bcd	2.6bcd	2.6bc	316.7mn	362.9łm	339.8gh
	16	77.9bcd	82.3b	80.1b	9.3d-h	10.4b-f	9.9cd	2.6bcd	2.6bcd	2.6bc	474.3i-l	500.9ij	487.6de
	12	73.5d-g	78.1bc	75.8c	8.8fgh	11.1bc	10.0cd	2.6bcd	2.7abc	2.7ab	689.2cd	761.6b	725.4b
Mean		**81.5A**	**80.6A**	**81.1A**	**9.0D**	**10.7B**	**9.9B**	**2.6B**	**2.6B**	**2.6B**	**493.4BCD**	**541.8B**	**517.6B**
27.04.	25	89.5a	76.7cde	83.1ab	9.4c-h	9.8b-h	9.6cd	2.5cde	2.5cde	2.5cd	275.1n	328.5mn	301.8h
	16	75.5c-g	75.9c-g	75.7c	9.7b-h	11.4b	10.6bc	2.4def	2.6bcd	2.5cd	417.8klł	485.1i-l	451.5ef
	12	74.0c-g	76.4c-f	75.2c	9.7b-h	10.9bcd	10.3cd	2.6bcd	2.6bcd	2.6bc	573.4fgh	610.2ef	591.8c
Mean		**81.8A**	**76.3B**	**79.1A**	**9.6CD**	**10.7B**	**10.2B**	**2.5B**	**2.6B**	**2.5BC**	**422.1D**	**472.7BCD**	**447.4B**
11.05.	25	74.1c-g	71.9ghi	73.0c	8.6gh	9.1e-h	8.9cd	2.2f	2.5cde	2.3e	358.7łm	415.8lł	387.2fg
	16	72.5e-h	72.2f-i	72.4c	8.7fgh	8.4h	8.6d	2.3ef	2.5cde	2.4de	441.6jkl	487.2ijk	464.4e
	12	68.1hij	67.9ij	68.0d	8.7fgh	9.2d-h	9.0cd	2.2f	2.6bcd	2.4de	522.2ghi	592.1efg	557.2cd
Mean		**72,2C**	**70.7C**	**71.5B**	**8.7D**	**8.9D**	**8.8C**	**2.2C**	**2.5B**	**2.4C**	**440.8CD**	**497.2BC**	**469.0B**

Means marked with the same letter do not differ significantly at α=0.05 level of probability

The two-year average period from sowing to commercial maturity of inflorescence stems also depended on the date of sowing: the later seeds were sown, the lower the value of the investigated trait was. It could be observed more clearly in the second year than in the first year. A similar correlation was observed by Wraga and Zawadzińska (2003) in determining the length of the period from sowing to the first harvest of *Craspedia globosa* stems. The length of the period from seed sowing to commercial maturity of inflorescence stems did not depend on plant density (Tab. 3).

The commercial maturity of inflorescence stems was reached earliest by the plants produced from transplants: 26 June in the first year, and 27 July in the second year of study, earlier by, respectively, 12 days and 15 days than the direct-seeded plants. Karczmarz and Laskowska (2003b) report that the harvest of stems of yellow ageratum (*Lonas annua)* grown from transplants was hastened by over two weeks. In our own study, dates of sowing into the ground later by 2 weeks and 4 weeks resulted in the plants entering the stage of harvest maturity of stems later by, respectively, 13 and 3 days in the first year of study, and by 4 and 13 days in the second year, in spite of the fact that, as stated above, the period of inflorescence formation shortened as the sowing was delayed. In the experiment of Wraga and Zawadzińska (2003), the first harvest of *Craspedia globosa* stems was carried out at the same time, in spite of the shift in the date of sowing by a month.

Cultivating plants with different densities resulted in differences in start dates of flowering and in dates of the occurrence of the commercial maturity stage by 1 – 5 days. A study of Burda (2000) on common sunflower (*Helianthus annuus*) shows that an increase in plant density does not affect the date of its flowering.

The sowing date and the related plant cultivation method affected morphological traits of inflorescence stems (Tab. 4). The plants obtained from transplants produced shorter inflorescence stems than the stems of the direct-seeded plants. Jadczak (2001) obtained similarly lower plants when cultivating common sage (*Salvia officinalis*) from transplants. A delay in the date of sowing directly into the ground resulted in the development of shorter inflorescence stems. The inflorescence stems of the plants obtained from the latest sowing into the ground (11 May) were almost 10 cm shorter than the stems of the plants obtained from the sowing a month earlier (13 April), what could be observed in both years of study, although Wraga and Zawadzińska (2003), in their study on *Craspedia globose*, did not find any effect of the date of sowing on the length of inflorescence stems.

The plant density had a significant effect on the two-year average height of the inflorescence stem. For all the dates of sowing, the height of the inflorescence stem of the plants grown with the largest spacing was significantly smaller than the height of the inflorescence stem of the plants grown with the largest plant density. Similarly, scarlet sage (*Salvia coccinea*) in an experiment of Krause (1997) and ribwort plantain (*Plantago lanceolata*) in an experiment of Kołodziej and Wiśniewski (2001), in which a larger plant density was used, grew stronger. In our own study, this correlation occurred clearly in the first year of study. In the second year, a tendency to produce shorter stems was observed in the plants growing at a larger spacing.

The date of sowing and the related cultivation method affected the length of the coloured inflorescence (Tab. 4). The plants grown from transplants produced the longest inflorescences compared to the direct-seeded ones, which was clearly marked in the second year of study. The plant density did not affect the length of the coloured inflorescence, although Krause (1997) found that an increase in density of planting of scarlet sage (*Salvia coccinea*) plants resulted in the formation of longer inflorescences. However, Karczmarz and Laskowska (2003b) did not demonstrate any effect of plant spacing on the quality of yellow ageratum (*Lonas annua)* inflorescences, similarly as Burda (2000) on the quality of common sunflower (*Helianthus annuus*) inflorescences. It should be stressed that in the second year of our study the plants produced from transplants had significantly longer inflorescences, in spite of the fact that seeds had been sown 2 weeks later compared to the first year of study. An analogous difference was observed with respect to other traits characterising the quality of inflorescence stems, which was probably attributable to a longer period of maturation of inflorescences in the second year of study and which indicates a response of sage to the pattern of climatic conditions. In the period following planting the transplants and in subsequent months, average decade air temperature was generally higher in the second year of study. The monthly rainfall total was also higher during the time of inflorescence development, and soil moisture determines, among other things, the size of bracteoles (Nowak 2002).

Inflorescences of the plants produced from transplants were more ornamental: they had significantly larger bracteoles – with a larger diameter, compared to inflorescences of the direct-seeded plants (Tab. 4). It could be observed particularly in the second year of study. Karczmarz and Laskowska (2003b) report that yellow ageratum (*Lonas annua)* stems of plants from transplants had a greater decorative value. In our own study, the smallest bracteoles were observed in the plants obtained from the latest date of direct sowing. The plant density did not affect significantly the dimension of the bracteoles. However, this factor affected the fresh weight of the above-ground portion. The

plants cultivated with a larger spacing, which had more room and less competition for nutrients, sunshine and water, (Moniuszko and Wiśniewski, 2001), grew larger and branched out more, what translated into a larger fresh weigh of the above-ground portion (Tab. 4), thereby flowering abundance, since each lateral stem ends with an inflorescence and produces next branches – secondary stems – which also flower. The dependence of plant weight on spacing was studied by Moniuszko and Wiśniewski (2001), noting that the weight of particular plants of valerian (*Valeriana officinalis*) decreased as their density per unit area increased. Karczmarz and Laskowska (2003b) obtained the highest yield of *Lonas annua* inflorescences from plants growing with the least density. Such plants were also most branched (Karczmarz and Laskowska (2003a). Martyniak-Przybyszewska and Wojciechowski (2003) obtained the highest yield of fresh herb of common basil (*Ocimum basilicum*) with the largest spacing of these plants. In our own study, the plants grown from transplants – obtained from the earliest-sown seeds – were characterised by the highest fresh weight. Likewise, Biesiada and Oszmiański (2003) obtained the highest fresh weight of *Echinacea purpurea* from plants from the earliest sowing, when investigating the effect of the date of planting resulting from different sowing dates on the growth of this plant. Ziombra (2001), when studying the influence of cultivation method on the yielding of common basil (*Ocimum basilicum*), obtained a higher yield of herb from transplants compared to direct sowing. Karczmarz and Laskowska (2003b) obtained more abundantly flowering plants of *Lonas annua* when they were grown from transplants.

CONCLUSIONS

1. *Salvia horminum* L. can be grown from transplants or it can be direct seeded. The cultivation from transplants is more advantageous due to the earlier flowering of plants, by about two weeks, and a better quality of inflorescences evaluated in terms of their length and size of bracteoles.
2. Direct sowing of *Salvia horminum* at two-week intervals from the 2nd decade of April till the 2nd decade of May ensures that by the end of August mature inflorescence stems are obtained, ready for cutting. A delay in the date of sowing results in the development of significantly shorter inflorescence stems, irrespective of the plant density.
3. Plant density does not affect significantly the length of the period of inflorescence formation and the date of flowering, but a larger spacing is favourable to plants growing big, what results in a larger fresh weight of the above-ground portion, in spite of inflorescence stems being shorter.
4. Sage grown from transplants responses to favourable climatic conditions by the development of bigger inflorescences.

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Wpływ sposobu uprawy na kwitnienie szałwii trójbarwnej *Salvia horminum* L. 'Oxford Blue'

Streszczenie

Szałwię trójbarwną (*Salvia horminum* L.) 'Oxford Blue' uprawiano z rozsady lub z siewu nasion wprost do gruntu. Zastosowano 4 terminy siewu: 15.03 lub 30.03 – w szklarni, w celu uzyskania rozsady, 13.04, 27.04. i 11.05. – wprost do gruntu. Zastosowano 3 zagęszczenia roślin: 25 roślin×m^2, 16 roślin×m^2, 12 roślin/m^2. Stwierdzono, że szałwia trójbarwna może być uprawiana z rozsady, jak też z siewu nasion wprost do gruntu. Uprawa z rozsady jest korzystniejsza ze względu na wcześniejsze o około 2 tygodnie zakwitanie roślin i lepszą jakość kwiatostanów ocenianą ich długością i wielkością przykwiatków. Wysiew nasion szałwii trójbarwnej bezpośrednio do gruntu w odstępach dwutygodniowych od II dekady kwietnia do II dekady maja zapewnia uzyskanie dojrzałych do cięcia pędów kwiatostanowych do końca sierpnia. Opóźnianie terminu wysiewu nasion powoduje wytwarzanie istotnie krótszych pędów kwiatostanowych niezależnie od zagęszczenia roślin. Zagęszczenie roślin nie wpływa istotnie na długość okresu formowania się kwiatostanów i termin ich kwitnienia, ale większa rozstawa sprzyja rozrastaniu się roślin co skutkuje większą świeżą masą części nadziemnej. Szałwia uprawiana z rozsady reaguje na korzystne warunki klimatyczne wytwarzaniem bardziej okazałych kwiatostanów.