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THE GROWTH AND FLOWERING OF *Salvia splendens* Sellow ex Roem. et Schult. UNDER FLOWERBED CONDITIONS

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A b s t r a c t

The aim of the study was to determine the influence of accompanying plants as well as bark mulching, common for green areas, on the growth, flowering and decorative values of scarlet sage *Salvia splendens* Sellow ex Roem. et Schult. The field experiment included two cultivars of sage: 'Red Torreador' and 'Luna'; two species of accompanying plants: French marigold – *Tagetes patula nana* L. 'Petit Gold' and flossflower – *Ageratum houstonianum* Mill.; as well as pine bark mulching. The control group was a monoculture of scarlet sage, without mulching.

Pine bark mulching had a beneficial influence on almost all growth and flowering characteristics of scarlet sage. The plants growing on mulched soil were higher, had more leaves and branches as well as their inflorescences were longer and had more whorls than the plants growing without mulching. *S. splendens* growing with other species had fewer leaves and fewer branches. Its side stems and lateral inflorescences were shorter. The accompanying species also limited the mass of scarlet sage. The vicinity of marigold and flossflower had no influence on the height of *S. splendens* plants, the number of whorls and flowers within inflorescences. The growth of scarlet sage was largely modified by weather conditions; the plants grew best between June 20th and July 18th, with the best decorative effect achieved in July. The drought caused the flowers to dry out during the second half of the summer each year, limiting the decorative values of sage.

Key words: scarlet sage, pine bark, mulch, *Tagetes patula, Ageratum houstonianum*

INTRODUCTION

Scarlet sage, *Salvia splendens* Sellow ex Roem. et Schult., is a plant originating from Brazil where it is a perennial and is locally used as a medicinal and spice plant. The bell-shaped flowers with a two-lipped corolla are borne in top inflorescences and grow out from between the bracts from summer till autumn (B o t s f o r d - C o m s t o c k , 1939; H u et al. 1997; P u c z e l , 2007). The specific epithet *splendens* comes from its splendid and bright red calyces and corollas. Its cultivars are popular and numerous (K a r a b a c a k et al. 2009). In the climatic conditions of Poland it is cultivated as an annual plant; its flowering starts at the end of June and continues until the first frosts set in. Flowering starts after around 12 to 14 weeks after sowing (S z y d ł o and S z y m k i e w i c z , 1996; C h m i e l , 2000). According to C r a w f o r d (1961), the maximal length of day in which the plants would not come into flower is 7 hours. As a seasonal flower, *Salvia splendens* has been used in green areas for years. Because of its decorative values and long period of flowering, it is an attractive and valuable plant used in flowerbeds. Scarlet sage is very frequently used to decorate parks and green areas within cities. It is suitable for borders, rock gardens, and for cultivation in containers. It blossoms richly and is suitable for large area plantations in public areas. It fills empty spaces and is frequently accompanied by other summer flowers. It is very presentable when accompanied by blue lobelia, violet flossflowers or yellow marigold. It is best planted on sandy-clay, fertile soils which are carefully cultivated and moderately humid. The best stand for scarlet sage is a sunny spot, but it also grows in half-shadow (C h m i e l , 2000; C h o j n o w s k a and C h o j n o w s k i , 2002; D e v e c c h i , 2006; K u m a r , 2011).

The scarlet sage is a typical flowerbed species and is frequently planted in the company of many other annual plants, differing in their growth characteristics and requirements, with the main criteria for their cho-

ice being their decorative values and the final visual effect. The aim of the study was to determine the influence of both the accompanying plants and common pine bark mulching on the growth, flowering and the decorative values of scarlet sage, *Salvia splendens* Sellow ex Roem. et Schult.

MATERIALS AND METHODS

The field experiment was conducted in the years 2005, 2006 and 2008 at the Felin Experimental Station of the University of Life Sciences in Lublin (Poland, 51°23'N, 22°56'E), on lessive soil derived from medium, dusty clay. Soil pH was in the range between 6.29 and 6.38 in 2005, from 5.35 to 5.84 in 2006, and from 5.30 to 5.95 in 2008. The experimental plant was the scarlet sage *Salvia splendens* Sellow ex Roemer et J.A. Schultes. The experiment was set up in a randomized block design with 4 replications. Two cultivars of sage were used during the experiment: 'Red Torreador' (with red flowers) and 'Luna' (with violet flowers); and two species of accompanying plants: French marigold – *Tagetes patula nana* L. 'Petit Gold', and flossflower – *Ageratum houstonianum* Mill., as well as pine bark mulching of the soil. The control group was a monoculture of scarlet sage, without mulching.

All the species were planted from seedlings grown in a greenhouse. Seeds were sown in boxes filled with a standard horticultural substrate. Seeds of the sage cultivars 'Red Torreador' and 'Luna' as well as flossflower seeds were sown on 17.03.2005, 17.03.2006, and 26.03.2008, respectively, while marigold seeds a month later, that is, on 14.04.2005, 15.04.2006, and 15.04.2008, respectively. The sage and flossflower seedlings were pricked out four weeks after sowing (13.04.2005, 14.04.2006, and 14.04.2008). The marigold was pricked out two weeks after sowing. Before the plants were planted, spring tillage was performed in the field and a multi-nutrient fertilizer (Azofoska) was applied; it was used at a rate of 4 kg per 100 m^2. The seedlings were planted in the field on May 21st, 2005; May 19th, 2006, and May 20th, 2008. The sage was planted at 25×25 cm intervals, while the marigold and flossflower at 20×25 cm spacing, in rows alternating with the sage plants. A replication consisted of 25 sage plants. After the seedlings were planted, half of the soil was covered with pine bark mulch. The layer of mulch was approximately 5 cm thick. This created a flowerbed with two cultivars of scarlet sage, marigold and flossflower. The weather pattern during the vegetative period of sage is shown in Table 1.

Table 1
Mean monthly air temperatures and amount of precipitation at the Felin Experimental Station in the years 2005, 2006 and 2008*

Month	Temperature (°C)				Amount of precipitation (mm)			
	Year							
	2005	2006	2008	Mean for 1951-2000	2005	2006	2008	Mean for 1951-2000
V	13.2	13.6	12.8	13.0	98.0	59.5	101.6	58.3
VI	16.0	16.9	17.7	16.5	55.9	37.9	25.9	65.8
VII	19.8	21.9	18.3	17.9	109.8	6.8	77.1	78.0
VIII	16.9	17.4	19.3	17.3	108.7	198.3	55.0	69.7
IX	14.9	15.7	12.6	12.9	18.0	11.0	102.2	52.1
X	8.8	10.1	10.1	7.9	8.6	14.2	55.5	40.3

*according to the Agrometeorological Laboratory of the University of Life Sciences in Lublin

The plants were hand weeded. No chemical protective agents were used. The plants were weeded 3 to 4 times during summer with a month's interval (from June 24th till August 25th). During the growing period, observations of flowering and growth of the plants were taken and the influence of accompanying plants on the development of scarlet sage was evaluated. Biometric measurements, including the following: height of the plants, number of leaves, number of stem branches, length of side stems, length of inflorescences on the main stem, length of inflorescences on the side stems, number of whorls in the main inflorescences, number of flowers per inflorescence, were made once a month (June 20th, July 20th, August 20th and September 15th). After the flowering ended, the weight of aboveground parts of 1 plant was taken. The dynamics of plant growth was measured twice a month from June 20th to September 15th.

Chemical analysis of the 0-20 cm soil layer at the beginning of the growing period and at the end of flowering of sage was also performed. After the soil was dried and sieved, the pH of the soil was measu-

red using the 1 M KCl potential method, the amount of available phosphorus and potassium with the use of the Egner-Riehm method, while the amount of magnesium with the ASA method, after extraction in 0.025 n $CaCl_2$. The results were then subjected to statistical analysis using analysis of variance. The significance of differences was set at p=0.05 using Tukey's test.

RESULTS AND DISCUSSION

Nutrient content in the soil

The changes in the content of P, K and Mg, depending on the plant species and mulching of the soil, are shown in Table 2. At the beginning of the growing period of sage in 2005, the 0-20 cm soil layer contained less potassium and more magnesium than in the following years of the experiment. The phosphorus content of the soil was similar. During all the study years, after the end of the growing season a decrease in the content of all nutrients in the soil was observed and it was especially significant in the case of potassium and magnesium.

Pine bark mulching of the soil did not substantially influence the content of phosphorus in the soil after the growing period of sage, while the contents of potassium and magnesium were significantly higher than in the treatment without mulch. The bark mulch protected those elements from being washed deeper into the soil profile, thus increasing their availability to the plant's roots. The three-year average shows that the largest amount of potassium and magnesium was drained from the mixed crop of sage and flossflower, but there were variations within this trend between years. In the years 2005 and 2006, the highest amount of potassium was determined in the soil in the sage monoculture, whereas in 2008 the magnesium content decreased most in the flowerbeds in which sage grew together with marigold.

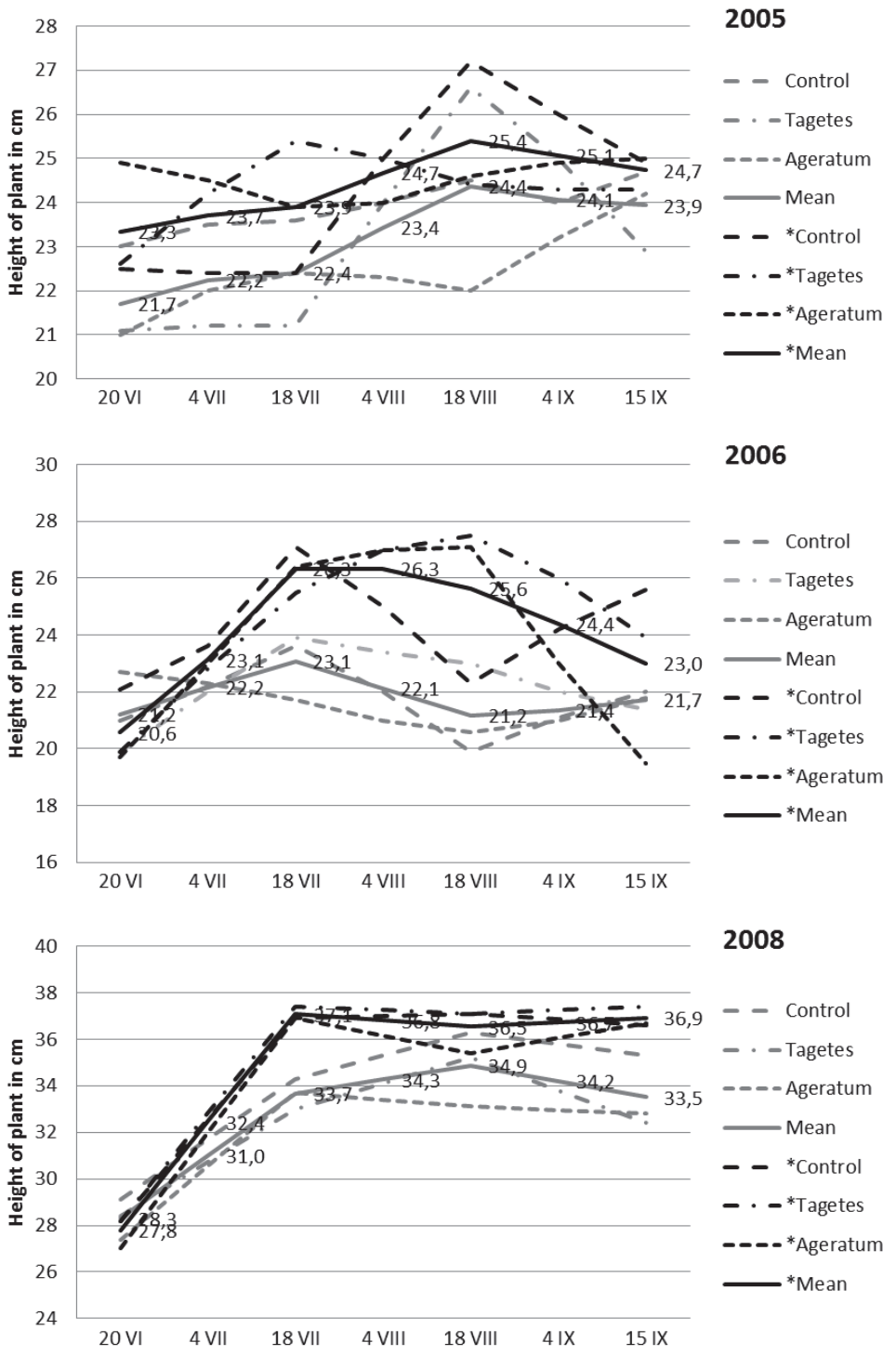
Table 2
The content of phosphorus, potassium and magnesium in the 0-20 cm soil layer – at the beginning and at the end of the growing season of sage, in the experimental years

Mulching	Accompanying species	Content of elements in mg × $100g^{-1}$ soil											
		P				K				Mg			
		2005	2006	2008	Mean	2005	2006	2008	Mean	2005	2006	2008	Mean
		Beginning of vegetation											
		13.21	13.73	13.94	13.63	14.26	25.45	20.16	19.96	14.42	9.22	8.75	10.80
		End of vegetation											
Without mulch	Control	12.50	11.13	13.71	12.45	11.85	16.90	10.07	13.49	13.30	7.80	7.72	7.76
	Tagetes	12.65	11.79	13.38	12.61	11.90	19.18	9.82	14.50	13.95	7.37	7.65	7.51
	Ageratum	12.35	12.14	13.42	12.64	13.00	17.00	8.66	12.83	13.00	7.85	7.61	7.73
	Mean	12.50	11.69	13.50	12.56	12.25	17.69	9.52	13.61	13.42	7.67	7.66	7.67
Pine bark	Control	12.30	13.53	12.98	12.94	12.20	18.67	11.32	15.00	13.50	8.22	8.21	8.22
	Tagetes	11.95	12.69	11.95	12.20	12.95	17.09	10.71	13.90	13.10	8.97	8.23	8.60
	Ageratum	12.35	12.49	12.87	12.57	12.55	20.31	9.16	14.74	12.85	7.85	8.38	8.12
	Mean	12.20	12.90	12.60	12.57	12.57	18.69	10.40	14.54	13.15	8.35	8.27	8.31
Mean	Control	12.40	12.33	13.35	12.69	12.03	17.79	10.70	14.24	13.40	8.01	7.97	7.99
	Tagetes	12.30	12.24	12.67	12.40	12.43	18.14	10.27	14.20	13.53	8.17	7.94	8.06
	Ageratum	12.35	12.32	13.14	12.60	12.78	18.66	8.91	13.78	12.93	7.85	8.00	7.92
	Mean	12.35	12.30	13.05	12.57	12.41	18.19	9.96	14.07	13.28	8.01	7.97	7.99
$LSD_{0.05}$ for:													
mulch		0.65	0.14	0.03	n.s.	0.13	0.14	0.03	0.06	0.10	0.14	0.03	0.05
accompanying species		0.97	n.s	0.04	n.s.	0.19	0.21	0.04	0.09	0.15	0.21	0.04	0.08
years		-	-	-	n.s.	-	-	-	0.09	-	-	-	0.08
date		n.s.	0.62	0.14	0.85	1.23	0.62	0.14	0.41	0.54	0.62	0.13	0.24

n.s. – not significant differences

Plant growth

Weather conditions during the experimental years modified the growth of sage (Fig. 1, Table 3). Important differences in plant height, number of leaves as well as number and length of side stems were observed. Natarajan and Kuehny (2008) observed changes in the height and thickness of stalks, the growth of sage roots and the anatomy of the leaves under the influence of the thermal factor. Taking into account the growth characteristics of sage during the experiment, the year 2008 should be considered to be the most beneficial for *S. splendens*.



*pine bark mulch

Fig. 1. Dynamics of *Salvia splendens* growth in the years 2005-2008 depending on the accompanying plant and bark mulching

Table 3
Selected characteristics of *Salvia splendens* growth during the peak growing season (July, August) depending on experimental factors

Factors		Characteristics of sage growth								
		Plant height (cm)		Number of leaves (№ plant^{-1})		Number of branches (№ plant^{-1})		Length of side stems (cm)		Plant weight (g)
		*VII	*VIII	VII	VIII	VII	VIII	VII	VIII	IX
Cultivar	'RedTorreador'	26.0	25.2	67.1	102.6	8.5	10.9	14.8	13.0	89.0
	'Luna'	29.5	30.3	66.6	92.8	7.2	8.5	16.8	17.7	98.1
Accompanying species	Control	28.0	27.9	70.3	103.4	8.1	12.3	17.0	15.7	111.8
	Tagetes	27.7	28.3	63.5	94.1	7.5	9.3	15.0	14.5	75.4
	Ageratum	27.5	27.1	66.9	95.5	7.9	11.4	15.5	15.8	93.4
Mulching	Without mulch	26.4	26.4	64.3	91.7	7.7	9.5	14.9	14.2	88.3
	Pine bark	29.1	29.2	69.5	103.7	7.9	10.0	16.8	16.5	98.8
Years	2005	23.1	24.2	60.4	90.6	7.5	8.2	11.6	14.2	102.5
	2006	24.7	23.4	49.6	90.9	7.5	10.0	14.8	9.6	57.3
	2008	35.4	35.7	90.6	111.5	8.5	11.0	21.1	22.2	120.8
Mean		27.7	27.8	66.9	97.7	7.8	9.7	15.8	15.3	93.5
LSD $_{0.05}$ for:										
cultivar		1.78	1.78	n.s.	4.71	0.81	0.81	0.63	0.63	4.89
accompanying species		n.s.	n.s.	n.s.	9.12	n.s.	1.10	0.86	0.86	9.34
mulch		1.78	1.78	4.71	4.71	n.s.	n.s.	0.63	0.63	4.89
years		2.35	2.35	9.12	9.12	n.s.	1.10	0.86	0.86	9.34

n.s. – not significant differences

The two sage cultivars, investigated in the experiment, did not differ substantially in their growth characteristics, but their reactions to different experimental factors were similar. The cultivar 'Luna' was higher, its side stems were longer and the plant weight at the end of the growing period was larger; while 'Red Torreador' formed more branches and leaves while in full growth (Table 3). In greenhouse cultivation, 'Red Torreador' reached a height of 29.8 up to 39.4 cm and produced 4.6-4.9 branches on average (N o w a k , 2007).

The first measurements were taken a month after the seedlings had been planted in the field (on June 20th). In 2008 the plants were the highest at that point, while in 2006 the plants were the lowest. Fig. 1 demonstrates the dynamics of the growth. In the years 2006 and 2008 the most dynamic growth of sage was observed in the period between June 20th and July 18th, when the plants reached their maximum height. In 2008 sage did not change its height until the middle of September, while in 2006 the height of the plants decreased from mid-August onwards. It was caused by the drought that occurred in this year, causing the sage plants to dry out prematurely. According to A u g e et al. (2003), scarlet sage is a plant with very good osmotic regulation mechanisms and it is highly resistant to the stress caused by the lack of water. Some of the authors, though, recommend watering it during droughts (C h m i e l , 2000). The growth of sage in 2005 had a completely different pattern. At the beginning the plants grew very slowly, reaching their maximum height on August 18th. After that date, up to the end of their flowering, their height gradually decreased as the flowers faded.

Soil mulching with bark had a positive effect on the growth of sage throughout the whole period of vegetation. During all measurements and in all the years studied, the sage plants growing on soil mulched with pine bark were higher than the plants growing in non-mulched soil. In the period of full flowering, mulching significantly increased the height of the plants (Table 3). Soil mulching contributes to better development of both the root system and the aboveground parts of the plant. Under the mulch, the best conditions and the main mass of the roots are in the 10-15 cm soil layer (D u r y e a et al. 1999). Mulching results in a large acceleration of generative development and increased crops (H e t m a n and P o g r o s z e w s k a , 1997; B ł a ż e w i c z - W o ź n i a k , 2009). The plants usually develop thicker stems and have more leaves. The composted pine bark caused better growth of gladiolus plants and increased the bulb crop (G r z e s z k i e w i c z , 1978). In the research of D ę b i c z (2007), soil mulching with composted pine bark had a detrimental effect on the dynamics of growth of perennials in the first and second year of their cultivation. Mulching gives better effects on light soils with fewer

nutrition components and smaller water capacity (Siwek, 1999).

The plants accompanying sage in the flowerbed did not influence its height (Table 3), but in 2005 a trend was observed that sage was higher in the monoculture on the plots mulched with pine bark (Fig. 1) and in the years 2006 and 2008 when it grew in the company of marigold, while it was the lowest when grown in non-mulched plots and accompanied by flossflower.

Bark mulch had a positive influence on the number of leaves of sage and the length of its side stems, and slightly increased the number of its branches (Table 3). Apart from protecting the soil from water loss and temperature oscillations, mulching also increases the amount of carbon dioxide in the vicinity of the leaves (Siwek, 1999).

The accompanying species limited some of the growth characteristics of sage. Sage growing in the company of marigold or flossflower had fewer leaves as well as fewer and shorter branches. This influence was particularly visible in August, when the accompanying plants grew out and were able to compete with sage.

Flowering

The analysis of the dynamics of development of sage flowers is a difficult task, as the average life span of a flower is just 3 to 4 days (Bożek, 2002). But the calyx, forming a circular casing, lasts longer in the inflorescence and still looks attractive even after the corolla has fallen off. In June the main inflorescence of sage showed a large number of flowers still at the bud stage (Fig. 2). There were a few open flowers and none had already faded away. This regularity was observed in all the study years, but the positive influence of bark mulching was already visible as early as June in 2008. The number of blooming and budding flowers was slightly larger in case of the mulched plots, when compared to those grown on unmulched soil. Investigating cv. 'Red Torreador', Nowak (2007) observed first flowering 31.6 days after the seedlings had been planted.

The situation changed in July. Flowers in the bud stage were scarce in the entire inflorescence, now dominated by blooming and overblown flowers. Senescent flowers, depending on the treatment combination, constituted up to a half of the inflorescence. The numerical advantage of senescent flowers over blooming flowers was particularly visible in the case of the cultivation without mulching. Mulch protected the soil from overheating. Daily temperature oscillations are lower under organic mulches as the soil warms and cools slower. Mulches are a good soil isolator (Skroch et al. 1992; Iles and Dosmann, 1999; Szewczuk, 2004; Błażewicz-Woźniak et al. 2011).

Only in 2006 and 2008 some scarce sage flowers were observed in August in the case of the mulched plots. The mulch protected the soil from water loss. Mulching of the soil, by lowering its temperature, limits evaporative water loss. Covering the soil with mulch can lead to the retention of large amounts of water in soil and improve its humidity (Szewczuk, 2004; Kęsik and Maskalaniec, 2005). In 2006, due to a severe drought, the plants stopped their growth in late July and their flowers dried and faded. The rainfalls in August restarted the flowering process, but there were few open flowers compared with the number of senescent flowers. The main inflorescences were drying out in September, and the decorative values of sage were transferred to the flowers on their lateral inflorescences.

The investigated sage cultivars differed not only in the colour of their flowers, but also in the characteristics of flowering (Table 4). The violet 'Luna' had longer inflorescences, which applied both to the main and lateral inflorescences, and more whorls in each inflorescence than 'Red Torreador'.

The beneficial influence of pine bark mulching on the flowering of sage in July was statistically confirmed (Table 4). Sage grown on mulched beds had longer main and lateral inflorescences and more whorls than the plants grown without mulch. Soil mulching with pine bark in *Allium ursinum* cultivation positively influenced the length of the flower stem, the length of the style, the diameter of the inflorescence, and the number of flowers per inflorescence and per plant (Błażewicz-Woźniak et al. 2011). The usefulness of willow bark for mulching flowerbed plants, such as sage, marigold and aster, was proven by Hetman and Szot (2002). In the case of ornamental roses, though, no increase in flowering after the addition of mulch was observed (Korszun and Zalewska, 2005). The positive influence of mulch on the flowering of sage was no longer substantial in August, as the flowers were already gradually drying out.

The number of flowers in the main inflorescence of sage did not significantly depend on the experimental conditions. The only differences were found between the experimental years. Similar to the growth, also the blossoming of sage was best in 2008. In July and August of that year sage produced the longest inflorescences, with the most flowers and whorls. In the experiments of Grigatti et al. (2007), the height of sage plants oscillated between 18.0 and 31.9 cm and the length of inflorescences between 2.9 and 8.8 cm, depending on the properties of the soil.

The cultivation of sage in flowerbeds, accompanied by marigold and flossflower, is commonly practiced because of the colour effect achievable through

the combination of those species (Chmiel, 2000; Chojnowska and Chojnowski, 2002), but the results of the present experiment have shown that the accompanying species, grown together with sage, influenced the length of its inflorescences both on the main and side stems. The largest inflorescences were produced by sage plants unaccompanied by any other species. Its main and lateral inflorescences were longest in July and had the most whorls. The shortest main inflorescences were, at the same time, observed in sage growing together with flossflower, and sage cultivated together with marigold had the shortest lateral inflorescences. This dependence was observed during both measurements. The vicinity of marigold and flossflower did not influence the number of flowers per inflorescence and the number of flower whorls.

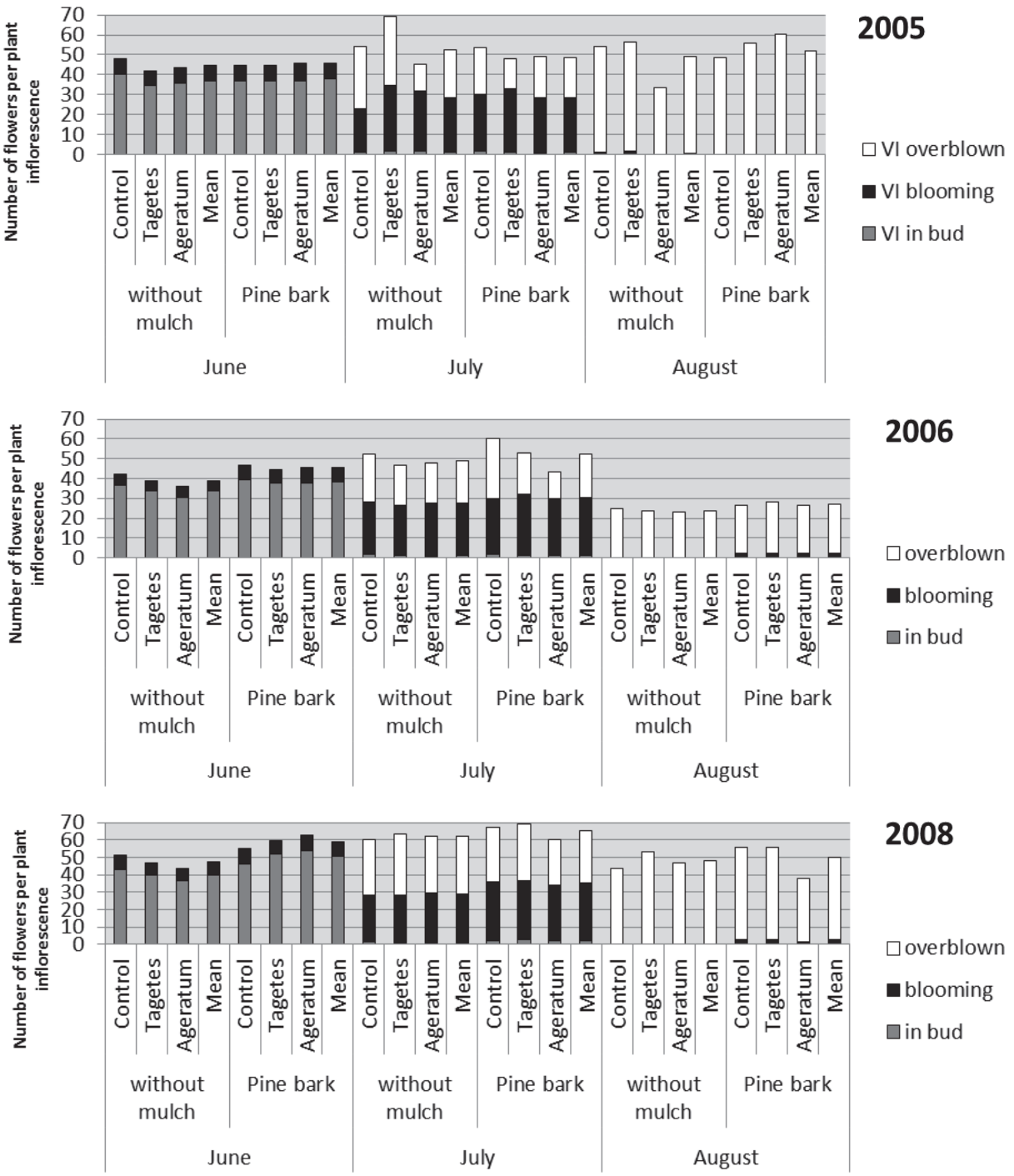


Fig. 2. The pattern of flowering of the main inflorescences of sage in 2005-2008

Table 4
Selected characteristics of *Salvia splendens* flowering during the peak growing season (July, August) depending on experimental factors

Factors		Characteristics of sage flowering							
		Length of main inflorescence (cm)		Number of whorls per inflorescence		Number of flowers per inflorescence		Length of lateral inflorescence (cm)	
		*VII	*VIII	VII	VIII	VII	VIII	VII	VIII
Cultivar	'RedTorreador'	11.5	8.1	10.1	7.8	57.7	38.0	9.9	8.8
	'Luna'	14.8	10.8	13.0	9.2	62.8	40.2	13.9	10.5
Accompanying species	Control	13.8	9.8	12.0	8.3	59.9	39.0	13.9	10.9
	Tagetes	13.4	9.5	11.5	8.8	61.2	38.9	10.7	8.7
	Ageratum	12.3	8.8	11.2	8.4	59.8	39.4	11.2	9.1
Mulching	Without mulch	12.0	9.2	9.9	8.4	60.7	38.9	10.5	9.5
	Pine bark	14.3	9.6	13.5	8.6	59.9	39.3	13.3	9.6
Years	2005	12.1	9.3	10.0	8.8	64.3	46.0	10.9	7.6
	2006	10.3	7.5	10.4	7.5	51.8	23.2	10.3	9.6
	2008	17.0	11.5	14.3	9.1	64.8	48.2	13.6	11.5
Mean		13.1	9.4	11.6	8.5	60.3	39.1	11.6	9.6
$LSD_{0.05}$ for:									
cultivar		0.72	0.72	1.19	1.19	n.s.	n.s.	0.67	0.67
accompanying species		1.10	n.s.	n.s.	n.s.	n.s.	n.s.	0.91	0.91
mulch		0.72	n.s.	1.19	n.s.	n.s.	n.s.	0.67	n.s.
years		1.10	1.10	1.63	1.63	7.45	7.45	0.91	0.91

n.s. – not significant differences

The limiting influence of the accompanying plants on the selected growth and flowering characteristics of sage did not lower its decorative effects. Monocultures of sage produced slightly higher plants with longer lateral stems and inflorescences because, since they grew in a large density (25×25 cm), they cast shadow on each other, causing the lateral stems and inflorescences to become longer. In the studies of Pogroszewska and Laskowska (2008), the height of the inflorescence stem of *Salvia horminum* L. grown with the largest spacing was significantly smaller than the height of the inflorescence stem of the plants grown with the largest plant density. Antonovics and Fowler (1985), analysing the cultivation of *S. splendens* together with *Linum grandiflorum,* came to the conclusion that the density had a large effect on vegetative and reproductive weight of *Salvia*. Although the immediate proximity of marigold and flossflower in the present investigations resulted in a lower number of leaves (especially in the lower part of the plant where the accompanying plants were growing) as well as in a reduction of the final weight of sage and a shortening of the inflorescences, but the number of flowers and flower whorls did not decrease. This caused the inflorescences to be more compact.

The influence of the accompanying plants on the decorative qualities of sage was modified by weather conditions. A major factor that lessened the decorative values of sage proved to be the shortage of water in the second half of the summer. It was also in the experiment of Iersel (1997) that the reaction of sage to the experimental factors differed under the influence of water and nutrition shortages. The present study proved that during drought the competition from the accompanying plants caused the sage flowers to dry out faster. Both marigold and flossflower have a very well developed root system that enables these species efficient water collection and survival even under drought conditions (Borch et al. 1998; Chmiel, 2000). Their immediate proximity caused the drying out of sage flowers as early as in August, especially in the plots in which sage grew together with them on non-mulched soil, while marigold was able to blossom till the first frosts. The negative influence of competition for water and its shortage were diminished by soil mulching with bark, which beneficially influenced all growth and flowering characteristics of sage. Bark mulching is therefore a procedure worth recommending for flowerbeds, not just because of its weed-removing qualities (Skroch et al. 1992). Bark mulch also protected the soil from the loss of magnesium and potassium, making these elements more available for the plants.

CONCLUSIONS

1. Pine bark mulching of the soil had a beneficial influence on almost all growth and flowering characteristics of scarlet sage. The plants growing on mulched soil were higher, had more leaves as well as their inflorescences were longer and had more whorls than the plants cultivated without the use of mulch.
2. The accompanying species influenced the growth of scarlet sage. *Salvia splendens* growing with other species had fewer leaves, lower weight, fewer branches and, as a consequence, fewer lateral inflorescences. Its lateral stems and inflorescences were shorter.
3. The immediate proximity of marigold and flossflower had no significant influence on the height of *S. splendens* plants, the number of whorls and the number of flowers per inflorescence.
4. The growth of scarlet sage was largely modified by weather conditions, but the strongest growth of the plants was observed in the period between June 20th and July 18th, with the most effective looks of the sage plants in July. Each year, the drought caused the flowers to dry and the decorative values of sage to decline during the second half of the summer.

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Wzrost i kwitnienie *Salvia splendens* Sellow ex Roem. et Schult. w warunkach kwietnej rabaty

Streszczenie

Celem przeprowadzonych badań było określenie wpływu roślin towarzyszących oraz powszechnie stosowanego w terenach zieleni ściółkowania gleby korą na wzrost, kwitnienie i walory dekoracyjne szałwii błyszczącej *Salvia splendens* Sello ex Roem. et Schult. W doświadczeniu polowym uwzględniono 2 odmiany szałwii: 'Red Torreador' i 'Luna'; 2 gatunki roślin towarzyszących: aksamitka rozpierzchła – *Tagetes patula nana* L. 'Petit Gold' i żeniszek meksykański – *Ageratum houstonianum* Mill. oraz ściółkowanie gleby korą sosnową. Kontrolę stanowiła uprawa jednorodna szałwii bez ściółkowania.

Ściółkowanie gleby korą sosnową korzystnie wpłynęło niemal na wszystkie cechy wzrostu i kwitnienia szałwii błyszczącej. Rośliny rosnące w glebie ściółkowanej były wyższe, lepiej ulistnione i rozgałęzione, a ich kwiatostany były dłuższe i miały więcej okółków niż uprawiane bez ściółki. *Salvia splendens* rosnąca z innymi gatunkami miała mniej liści i mniej rozgałęzień. Jej pędy i kwiatostany boczne były krótsze. Gatunki towarzyszące powodowały wytworzenie mniejszej masy przez szałwię. Sąsiedztwo aksamitki i żeniszka nie miało istotnego wpływu na wysokość roślin *S. splendens*, liczbę okółków i kwiatów w kwiatostanie. Wzrost szałwii błyszczącej był w dużym stopniu modyfikowany przebiegiem pogody, jednak najsilniej rośliny rosły w okresie od 20 czerwca do 18 lipca, natomiast najbardziej efektownie szałwia wyglądała w lipcu. Susza rokrocznie powodowała zasychanie kwiatów zmniejszając walory dekoracyjne szałwii w drugiej połowie lata.