Salvia officinalis: Influence of Cutting Frequency, Cutting Height and Date of the Last Harvest before Winter

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Abstract

Common sage (*Salvia officinalis* L.) is one of the aromatic plants most cultivated in Switzerland. In order to guarantee an optimal sage harvest, the cutting frequency as well as the cutting height and date of the last harvest before winter were analysed. These trials were conducted in mountain areas of Switzerland from 2003 to 2006. With 3 cuts per year, the yield in dry material and in essential oil, as well as the leaves rate and the resistance to winter frost were higher than with 2 cuts. A last harvest early before winter, at the beginning of September, strengthened the resistance to winter frost only for the process with 3 harvests per year. With a cut at 15 cm for the last harvest, there were significantly fewer damages caused by winter frost than with a low cut at 5 cm. At contrary, the higher cut favoured the formation of floral stems. Shortening the stubbles to about a length of 5 cm in early spring considerably reduced the formation of floral stems, not wanted for the sage. In conclusion, 3 harvests per year with a last cut at the latest towards the beginning of September at a height of 15 cm, followed by a stubbles shortening to about 5 cm in the spring favours the productivity, persistence and quality of the sage in mountain areas.

INTRODUCTION

The officinal sage (*Salvia officinalis* L.) is one of the aromatic plants most cultivated in Switzerland. It is used in priority by food industry and is useful amongst other things for the production of candies, herb teas, ice tea or spice mixtures. The overwintering of a sage culture, a species of Mediterranean origin, can cause problems in Swiss mountain area. Important winter frost damages are regularly noted. Various observations showed that the harvest processes can influence the resistance to winter frost (Rey, 1991).

In order to guarantee an optimal sage harvest, the cutting frequency as well as the cutting height and date of the last harvest before winter were studied in different sites in Swiss mountain area. In addition to the yield, the leaf proportion, the content of essential oil, the winter frost resistance and the number of flower trusses in the spring were analysed.

MATERIALS AND METHODS

The sage cultivar used for these tests was 'Regula'. This cultivar is an hybrid resulting from a crossing between a sterile male clone and a fertile male clone selected by Agroscope Changins-Wädenswil ACW. 'Regula' is available at DSP AG, Delley, Switzerland (www.dsp-delley.ch). Carron et al. (2005) and Rey et al. (2000) described the characteristics of Regula.

In order to analyse the incidence of the cutting frequency and the cutting height at the last harvest before the winter on the performance of officinal sage, trials were conducted in Arbaz (VS, altitude 920 m, southern exposure; 20% slope, sandy soil) and in Bützberg (BE, altitude 480 m, south-western exposure, 5% slope, loamy soil) according to the guidelines of organic farming. After sowing, on March 27 in 2002 and transplantation to trays, on April 10, the seedlings were planted in the field on May 16 at Arbaz and on May 17 at Bützberg. The cutting height was 5 cm, except for the last cut

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before the winter. The cutting height was either 15 cm above ground (high cut) or 5 cm (low cut). In order to analyse the incidence of the cutting frequency and the date of the last harvest on the performance of sage, a trial was conducted in Arbaz. After sowing at the end of March 2003 and transplantation three weeks later, the seedlings were planted in the field on May 27 at Arbaz. The Tables 1 and 2 summarise the harvesting dates of these experiments for the various processes.

In order to analyse the incidence of the shortening of stubbles from 15 cm to 5 cm in early spring on the formation of flower trusses of sage, a trial was conducted in Venthône (VS, altitude 900 m, southern exposure; 15% slope, sandy soil) on a crop in the second year after planting and one in the third year. The shortening of stubbles was carried out on May 8, 2006 at the beginning of vegetation period and the control of flower trusses on June 9, 2006. The first harvest took place on June 14.

The plantation distance was 0,70 m x 0,30 m (4,8 plants/m^2) for all the trials (elementary plot = 15 m^2). Fertiliser authorised in organic farming (Biorga N, Granuphos, Patentkali) were used according the guidelines of fertilisation for sage (in kg per hectare: 100 NR, 30 P_2O_5, 180 K_2O and 30 Mg) (Carlen et al., 2006). The nitrogen was splitted (spring and after the 1st cut). In Arbaz and Venthône, the sage was irrigated, on the other hand in Bützberg, irrigation was not possible. No plant protection treatment was applied. The weeding was made manually between the plants and with a harrow between the lines.

The harvested plants were dried at a temperature from 35 to 40°C. Hydrodistillation was made according to the European pharmacopoeia (but without use of xylene). The experimental designs were complete randomised block with 4 replications.

RESULTS AND DISCUSSION

The cutting height at the last harvest before the winter significantly influenced the winter frost resistance of sage (Tables 3 and 4). With a cutting height of 5 cm the winter frost damages were significantly more important than with a 15 cm. These results confirm the observations of Rey (1991). With longer stubbles it seems that more soluble reserves, sugars and starch, remain available to the sage plants, increasing frost resistance (Carlen et al., 2006a). The cutting height at the last harvest before the winter also influenced the intensity of flowering (Tables 3 and 4). A higher cutting height supported the frost resistance, however, formation of flower trusses is favoured in the following spring. A shortening of the stubbles from 15 cm to approximately 5 to 10 cm in spring strongly reduced the formation of flower trusses, without penalising too much the yield at the first harvest (Table 5). With a high cut in autumn and a shortening of stubbles in the spring it is possible to reconcile the winter frost resistance and a reduced formation of flowers in the spring.

The cutting frequency had only little influence on the behaviour of sage. The essential oil and dry matter yield tended to be higher with 3 cuts than with 2 cuts (Tables 3, 4 and 6). On the other hand the cutting frequency had only very few effects on the content of essential oil in the leaves and on its chemical composition (results not shown), on the number of flower trusses and on winter frost damages.

The influence of the date of the last harvest before winter on the frost damages was different for the two cutting frequencies (Table 6). For the process with 2 cuts per year, the date of the last harvest did not influence the frost resistance. On the other hand with 3 cuts per year, a last harvest at the beginning of September clearly stood out from the other processes. One of the reasons is probably a greater total sugars and starch contents in the stubbles with this process in comparison with later harvests (Carlen et al., 2006a). Moreover, with 3 cuts a greater residual leaf aera after the last cut was observed in comparison with two cuts. This residual leaf area can probably make photosynthesis in autumn and even in the winter and provide sugars to the plant as shown for white clover (Lüscher et al., 2001) and alfalfa (Meuriot et al., 2005). The content of soluble sugars and starch and the residual leaf area seem important factors for a better understanding of the winter frost tolerance of sage.

In conclusion, 3 harvests per year with a last cut at the latest towards the

beginning of September at a height of 15 cm, followed by a stubbles shortening to about 5 cm in the spring favours the productivity, persistence and quality of the sage in mountain areas.

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Tables

Table 1. Harvesting dates of sage (cultivar Regula) in Arbaz and Bützberg in relation to the cutting frequency processes from 2002 to 2004.

Site	Year	Harvesting date			Harvesting date	
		1st harvest	2nd harvest	3rd harvest	1st harvest	2nd harvest
Arbaz	2002	-		28 August	-	28 August
	2003	19 May	23 July	19 Sept.	17 June	2 Sept.
	2004	8 June	2 August	21 Sept.	30 June	21 Sept.
Bützberg	2002	-	-	29 August	-	29 August
	2003	16 May	24 July	18 Sept.	18 June	3 Sept.
	2004	9 June	3 August	16 Sept.	6 July	16 Sept.

Table 2. Harvesting dates of sage (cultivar Regula) in Arbaz in relation to the cutting frequency treatments and the date of the last harvest form 2003 to 2005.

Year	Harvesting date			Harvesting date	
	1st harvest	2nd harvest	3rd harvest	1st harvest	2nd harvest
2003	-	-	26 August	-	26 August
2004	27 May	2 August	1 Sept. 21 Sept. 6 Oct.	30 June	1 Sept. 21 Sept. 6 Oct.
2005	28 June	8 August	5 Sept. 19 Sept. 13 Oct.	18 July	5 Sept. 19 Sept. 13 Oct.

Table 3. Influence of harvest frequency and cutting height at the last harvest before winter in Arbaz (VS) on annual dry matter yield, annual essential oil yield and winter frost damage.

Harvests per year	Cutting height at the last harvest	Annual yield (DM) (t/ha)		Annual yield of essential oil (L/ha)		Death plants after winter (%)		Number of flower trusses per plant	
		2003	2004	2003	2004	Spring 2003	Spring 2004	Spring 2003	Spring 2004
2	5 cm	4,8	2,7 ab	78,1	48,0 b	3	38 a	3 b	18 a
	15 cm	4,8	3,0 a	77,1	51,6 a	7	7 b	65 a	23 a
3	5 cm	4,2	1,8 b	63,3	30,0 b	3	46 a	3 b	0 b
	15 cm	5,8	3,4 a	83,3	54,6 a	7	2 b	65 a	23 a

Different letters indicate significant differences (p<5%)

Table 4. Influence of harvest frequency and cutting height at the last harvest before winter in Bützberg (BE) on annual dry matter yield, annual essential oil yield and winter frost damage.

Harvests per year	Cutting height at the last harvest	Annual yield (DM) (t/ha)		Annual yield of essential oil (l/ha)		Death plants after winter (%)		Number of flower trusses per plant	
		2003	2004	2003	2004	Spring 2003	Spring 2004	Spring 2003	Spring 2004
2	5 cm	2,2 b	2,2 b	33,3 b	35,7 b	24 a	41 a	10 b	7 b
	15 cm	2,2 b	3,1 a	30,3 b	54,1 a	10 b	5 b	34 a	23 a
3	5 cm	3,6 a	2,2 b	44,9 a	39,5 b	24 a	33 a	10 b	2 b
	15 cm	3,6 a	2,9 ab	46,4 a	54,1 a	10 b	7 b	34 a	1 b

Different letters indicate significant differences (p<5%)

Table 5. Influence of reducing the length of stubbles from 15 to 5 cm just after winter on the number of flower trusses and the yield at the first harvest in the spring on sage (cultivar Regula) in Venthône.

Harvests per year (2005)	Number of flower trusses per plant (Spring 2006)		Yield (DM) (t/ha) at the 1st harvest (Spring 2006)	
	without reducing the length of stubbles	with reducing the length of stubbles	without reducing the length of stubbles	With reducing the length of stubbles
2	26 a	3 b	1,70	1,50
3	18 a	0 b	1,09	0,92

Different letters indicate significant differences between the processes 'reducing length of stubbles' ($p<5\%$)

Table 6. Influence of harvest frequency and cutting date at the last harvest before winter on annual dry matter yield, annual essential oil yield and winter frost damage.

Harvests per year	date of the last harvest	Annual yield (DM) (t/ha)		Annual yield of essential oil (l/ha)		Death plants after winter (%)	
		2004	2005	2004	2005	Spring 2004	Spring 2005
2	begin of Sept.	5,7 b	3,2 b	74,3 b	63,8 b	0	48
	mid of Sept.	6,3 a	4,4 a	88,3 a	76,4 a	0	47
	begin of Oct.	6,3 a	4,7 a	82,0 a	75,0 a	0	46
3	begin of Sept.	6,9 b	4,0	94,1 b	84,6	0	16 b
	mid of Sept.	7,3 ab	3,9	107,3 a	82,0	0	28 a
	begin of Oct.	7,7 a	4,6	112,9 a	86,2	0	34 a

Different letters indicate significant differences between the processes 'date of the last harvest' ($p<5\%$)