CBCS
http://agrobiol.sggw.waw.pl/cbcs

Communications in Biometry and Crop Science
Vol. 1, No. 2, 2006, pp. 106–110

International Journal of the Faculty of Agriculture and Biology,
Warsaw Agricultural University, Poland

NOTE

Seedling quality of common sage (*Salvia officinalis* L.) as affected by seedling production methods

Ömer Çalişkan[1], Ali K. Ayan[1], Cüneyt Çirak[2*]

[1] Ondokuz Mayıs University, Vocational School of Bafra, Samsun, Turkey.
[2] Department of Agronomy, Faculty of Agriculture, Ondokuz Mayıs University, Samsun, Turkey.
* Corresponding author: Cüneyt Çirak, E-mail: cuneytc@omu.edu.tr

CITATION: Çalişkan, Ö., Ayan, A.K., Çirak, C. (2006). Seedling quality of common sage (*Salvia officinalis* L.) as affected by seedling production methods. *Commun. Biometry Crop Sci.* 1 (2), 106-110.

Received: 18 May 2006, Accepted: 20 September 2006, Published online: 28 September 2006

ABSTRACT

The study was conducted to determine the effects of four different seedling production methods (i.e., open seedbed, greenhouse seedbed, float system and modified float system) on the seedling growth and quality of common sage. Sowing rates were 1 g per m^2 in an open seedbed and a greenhouse seedbed system, whereas the sowing rate was one seed per cell in the float and modified float systems. Emergence period, seedling growth period, the fresh and dry weights of aerial parts of seedlings, the fresh and dry weights of roots, seedling height, root height and stem diameter were determined as agronomical observations and measurements. The greenhouse seedling method was found to be superior over the other methods.

Key Words: *common sage, seedling production, greenhouse seedling method.*

INTRODUCTION

Common sage (*Salvia officinalis* L.) is a perennial shrub, native to Mediterranean Basin. It is believed to have originated from Southern Europe or Anatolia (İlisulu, 1992; Baydar, 2002). For hundreds of years, *Salvia* species have been used as traditional medicinal plants because of their sedative, antiseptic, antispasmodic, anti-inflammatory, and diuretic properties (Ceylan, 1987). They are also used in food and cosmetic industries for the production of gargling preparation, hair-strengthening shampoo, deodorant, and face cream (Hemphill and Hemphill, 1990). The genus *Salvia* is represented in Turkey by 87 species, of which 44 are endemic (Nakipoğlu, 1993). Turkey is one of the most important common sage-producing countries of the world. However, the production has been supplied mainly by over-collecting of the plant material from nature to a great degree, and this phenomenon poses a great risk to native *Salvia* populations. Hence, elucidating the cultivation requirements of sage has an important role both in conservation of native *Salvia* germplasm and in meeting the export demand for Turkey.

Common sage is traditionally grown either by sowing the seeds directly in the field or by using different kind of seedling methods due to its large seeds. It can also be propagated by using rooted cuttings (Baydar, 2002). Common sage has been suggested to propagate via cuttings, which exhibit high essential oil content and yield (Arslan et al., 1994, 1995). In a two year-field study, which was conducted under Poland ecological conditions, direct seed sowing in the field and seedling method were compared as common sage production methods. Although no difference was detected between the two methods in mean yield in the first year, seedling method produced higher yield than direct sowing in the second year (Jadczak, 2001). It is also noteworthy to mention that using seedling method in common sage production is necessary for some production areas, such as the Black Sea region of Turkey, where vegetation period is not long enough to sow the seeds directly in fields. Hence, producing healthy and high quality seedlings is one of the most important agricultural practices for high productivity in sage cultivation (Zawiślak and Dyduch, 2003). The aim of the present study was to evaluate the effects of open seedbed, greenhouse seedbed, float system and modified float system on seedling quality of common sage.

MATERIALS AND METHODS

The study was conducted using the *Salvia officinalis* L. seeds provided by the Aegean Agricultural Research Institute, in the experimental area of the Vocational School Profession of Bafra in 2005. During the experimental period, mean temperature was 17.1°C, annual precipitation was 508 mm and relative humidity was 76.3% (Anonymous, 2005). Seedbeds for different seedling production methods were established on April 8, 2005.

Experimental design was a randomised complete-block design with three replications, utilizing the seedling production methods, open seedbed, greenhouse seedbed, float system and modified float system, as a treatment factor. Plots were 5 m × 80 cm each, with a distance of 1 m between blocks for open and greenhouse seedbeds. The plots were prepared for sowing by spreading a 1 cm-thick layer of manure on the surface. For the float system and modified float system, pools, 16.5 cm in depth, were prepared as described previously (Ayan et al., 2006) and separated into 135 by 170 cm sections, each of which was sufficient for three trays. The pools were covered by polyethylene sheets after sowing and filled with 2220 L of water (pH 6.5). Fertiliser at the rate of 70 g NPK (20-10-20) per pool was added. Sowing rates were: 1 g per m^2 in the open seedbed and greenhouse seedbed systems, and one seed per cell in the float system and modified float system. After sowing, the open seedbed and greenhouse seedbed were irrigated twice a day. In the float system, trays remained in pools during the course of experiment. In the modified float system, trays remained in pools for one hour in the morning (8-9 a.m.) and one hour in the evening (17-18 p.m.); the rest of the time, they were outside of water.

During the course of seedling development, emergence period, and seedling growth period, fresh and dry weights of aerial parts of seedlings, fresh and dry weights of roots, total fresh and dry weights of seedlings, stem height, root height and stem diameter were measured. Data from the experiment were subjected to an analysis of variance (ANOVA) and significant differences among means were compared via the Duncan's multiple range test, at the 0.01 and 0.05 probability level, using MSTAT statistical software.

RESULTS AND DISCUSSION

Analyses of variance revealed that the effects of seedling production methods on fresh and dry weight of aerial parts, fresh and dry root weight, total fresh and dry weight, root height and stem height were significant, they were nonsignificant for emergence period, seedling growth period and stem diameter (Table 1). Mean values of the morphological traits examined are shown in Table 2.

Table 1. Analyses of variance for the various traits studied.

Source of variation	Degrees of freedom	Mean square	F value
Emergence period			
Replication	2	0.750	
Seedling pr. meth.	3	2.083	0.2271ns
Error	6	1.083	
CV(%): 9.9			
Seedling growth period			
Replication	2	20.333	
Seedling pr. meth.	3	14.774	3.9117ns
Error	6	3.778	
CV(%): 3.90			
Fresh weight of aerial parts			
Replication	2	0.0005	
Seedling pr. meth.	3	5.507	2260.5364**
Error	6	0.002	
CV(%): 1.90			
Fresh root weight			
Replication	2	0.0005	
Seedling pr. meth.	3	0.599	417.9302**
Error	6	0.001	
CV(%): 6.78			
Total fresh weight			
Replication	2	0.004	
Seedling pr. meth.	3	3.833	2787.5446**
Error	6	0.001	
CV(%): 1.18			
Dry weight of aerial parts			
Replication	2	0.026	
Seedling pr. meth.	3	0.110	22.0001**
Error	6	0.005	
CV(%): 1.04			
Dry root weight			
Replication	2	0.019	
Seedling pr. meth.	3	0.022	36.6667**
Error	6	0.0006	
CV(%): 5.11			
Total dry weight			
Replication	2	0.000	
Seedling pr. meth.	3	0.091	18.2222**
Error	6	0.005	
CV(%): 2.1			
Root height			
Replication	2	0.226	
Seedling pr. meth.	3	2.948	6.9857*
Error	6	0.422	
CV(%): 4.07			
Stem height			
Replication	2	0.331	
Seedling pr. meth.	3	9.303	7.3425*
Error	6	1.267	
CV(%): 0.61			
Stem diameter			
Replication	2	0.008	
Seedling pr. meth.	3	0.009	4.5555ns
Error	6	0.002	
CV(%): 1.54			

^{ns} not significant; * significant at 0.05 probability level, ** significant at 0.01 probability level.

Table 2. The effects of different seedling production methods on some morphological characters of common sage.

Observations	OS			GS			FS			MFS		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Emergence period (day)	9	11	10	9	8	8	10	7	8	9	8	8
Seedling growth period (day)	56	53	55	48	42	45	48	42	45	45	44	45
Fresh weight of aerial parts (g)**	2.21	2.16	2.19 b	4.65	4.56	4.60 a	1.76	1.67	1.72 b	1.90	1.83	1.86 b
Fresh root weight (g)**	0.19	0.15	0.17 c	0.23	0.20	0.20 c	0.80	0.72	0.76 b	1.12	1.07	1.09 a
Total fresh weight (g)**	2.40	2.31	2.36 b	4.82	4.77	4.80 a	2.50	2.45	2.48 b	3.00	2.91	2.95 b
Dry weight of aerial parts (g)**	0.373	0.368	0.371 b	0.736	0.727	0.732 a	0.335	0.328	0.330 b	0.355	0.347	0.351 b
Dry root weight (g)**	0.58	0.51	0.054 b	0.54	0.45	0.049 b	1.001	0.092	0.097 a	1.001	0.097	0.099 a
Total dry weight (g)**	0.429	0.420	0.425 b	0.786	0.775	0.781 a	0.432	0.423	0.427 b	0.456	0.443	0.450 b
Root height (cm)*	6.9	6.3	6.6 b	9.0	8.6	8.8 a	7.5	6.6	6.9 ab	7.4	6.4	7.1 ab
Stem height (cm)*	11.9	11.4	11.6 b	15.9	14.7	15.3 a	12.2	11.2	11.7 b	14.3	13.1	13.8 ab
Stem diameter (cm)	0.47	0.36	0.42	0.48	0.36	0.43	0.44	0.35	0.38	0.47	0.36	0.39

OS: open seedbed, GS: greenhouse seedbed, FS: float system, MFS: modified float system. Different letters in each row denote a significantly difference between means at: *the level of $P<0.05$ and **the level of $P<0.01$, respectively according to Duncan's multiple range test.

Greenhouse seedbed method produced the highest values for the fresh and dry weights of aerial parts of the seedlings (4.60 and 0.732 g, respectively) and also for their total fresh and dry weights (4.80 and 0.781 g, respectively). This method showed superiority over the other methods with regard to these parameters and the differences among seedling production methods was significant ($P<0.01$). Considering the significant and positive relationship between seedling size and productivity, as reported by Zawiślak and Dyduch (2003), the present results indicate the importance of greenhouse seedbed method for sage production.

Contrary to the observations from the greenhouse seedbed method, higher values of fresh and dry root weight were observed in the modified float system (1.09 and 0.099 g, respectively). This result is not surprising given the fact that lateral roots of the seedlings established in the modified float systems as well as the float system were not damaged during the course of seedling removal. Thus, their fresh and dry weights were higher. This is the main advantage of the modified float systems for seedling production. Similar results was also observed for tobacco seedlings (Peek and Reed, 2002; Smith et al., 2002).

Seedlings established in the greenhouse seedbed and modified float system had the longest roots and stems in this study (8.8-7.1 cm root and 15.3-13.8 cm stem for greenhouse seedbed and modified float system, respectively) and the difference between these methods for root and stem heights was found to be nonsignificant. The greenhouse seedbed and modified float system seem to be more suitable than other methods for producing vigorous seedlings of common sage. The reason for this might be that they provided both warm and humid medium for seedling development and sufficient oxygen for rooting.

CONCLUSIONS

The main conclusions of the research can be summarised as: 1. Greenhouse seedbed is the most suitable method for seedling production of common sage, because the most vigorous seedling development and highest total fresh and dry weights were observed with this method. 2. Modified float system is also a promising method for sage seedling production. In this method, root development was superior and lateral root damage induced by pulling was less than in the other systems. This advantage of the modified float system reduces transplantation loss and accelerates the development of young plants in the field. 3. Despite the positive results, it should be noted that this is a one-year and one-environment study. Therefore, the present data are preliminary and not sufficient to make substantial conclusions. Further studies are needed to confirm the results.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. Kürşat Demiryürek, Department of Agricultural Economy, Faculty of Agriculture, University of Ondokuz Mayis, for his assistance in translation.

REFERENCES

Anonymous (2005). *Meteorological data for Bafra*. Bafra Meteorology Station, Samsun, Turkey.

Arslan, N., Gürbüz, B., Yılmaz, G. (1994). Effects of different media on rooting of sage. *J. Fac. Agric. GOP* 1, 125–130.

Arslan, N., Gürbüz, B., Yılmaz, G. (1995). The effects of IAA applications on generative development, cutting date and rooting of cutting in sage (*Salvia officinalis* L.). *Turkish J. Agric. Forest*. 19, 83–97.

Ayan, A.K., Çalişkan, Ö., Çirak, C. (2006). Seedling quality of flue-cured tobacco as affected by different types of peat. *Commun. Biometry Crop Sci.* 1 (1), 56–62.

Baydar, H. (2002). Studies on yield and essential oil quality of thyme (*Origanum onites* L.) under Isparta conditions. *S.D.Ünv. Fen Bilimleri Ens. Der.* 6, 17–24 (in Turkish).

Ceylan, A. (1987). *Medicinal Plant II*. (*Essential oil plants*). Aegean University Agricultural Faculty publications, No: 481 (in Turkish).

Hemphill, J., Hemphill, R. (1990). *Herbs: their cultivation and usage*. Blandford Press, London.

İlisulu, K. (1992). *Medicinal plants and spices*. Ankara University Agricultural Faculty publications, No: 1256 (in Turkish).

Jadczak, D. (2001). The influence of the manner of seedling production on the quantity and quality of leaf yield of sage. *Annales Universitatis Mariae Curie-Sklodowska. Sectio EEE, Horticultura* 9, 57–63.

Nakipoğlu, M. (1993). Ecological studies on Turkish *Salvia* species. *Turkish J. Agric. Forest*. 1, 21–25.

Peek, D.R., Reed, T.D. (2002). *Burley tobacco production guide. Greenhouse transplant production guide*. http://www.ext.vt.edu/pubs/tobacco/436-050/436-050.html.

Smith, W.D., Boyette, M.D., Moore, J.M., Summer, P.E. (2002). *Transplant production in greenhouse*. http://www.griffin.peachnet.edu/caes/tobacco.

Zawiślak, G., Dyduch, J. (2003). The relation between seedling size and yield of sage (*Salvia officinalis*). *Annales Universitatis Mariae Curie-Sklodowska. Sectio EEE, Horticultura* 12, 1–7.