Growth of Lavender (*Lavandula officinalis*) and Rosemary (*Rosmarinus officinalis*) in Response to Different Mulches

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Abstract

Weed control is a serious problem in the cultivation of medicinal and aromatic plants (MAPs) because most are not successfully competitive with noxious plants. The aims of the project were to verify the possibility of growing lavender (*Lavandula officinalis*) and rosemary (*Rosmarinus officinalis*) in a profitable way in the Sacra Valley (northwestern Italy); to control weeds by mulching, comparing this technique to an undisturbed situation (control), and to analyze the durability of different black mulches used (polyethylene, transpiring, draining types). Experiments in the field started on 31 May 2001, transplanting plants arranged in a grid spaced 0.6 x 0.6 m in a loamy soil, provided with an overhead irrigation system of sprinklers. Experiments consisted of 2 species by 4 mulch treatments by 4 blocks. Periodical measurements of canopy height and diameter, and flowered branch counting were taken to study plant growth. Weeds were identified and their development in the treatments was assessed in terms of density and covering. In the control plots, both lavender and rosemary suffered weed invasion. Plants grown with polyethylene and transpiring mulch increased canopy height and width more than plants grown with the other treatments. From the beginning, the draining mulch was perforated by some weed species (*Setaria viridis* and *Echinochloa crus-galli*), which covered about 50 % of the mulch at the end of the growing season. Results indicated that the best mulches to cultivate lavender and rosemary were polyethylene and transpiring types.

INTRODUCTION

In the last years particular attention was paid in Piedmont (northwestern Italy) to the possibility of cultivating medicinal and aromatic plants (MAPs) to diversify agricultural production by a new productive trend. In fact, the cultivation of MAPs could contribute to raise farm income and to create new job opportunities, primarily in areas that are either marginal or abandoned by inhabitants that moved to cities and suburbs.

Aromatic plants have been cultivated and commercialised for centuries; nevertheless, little is known about cultural techniques and production, and little technical information is available for growers (Simon, 1986). Weed control is very important because none of the aromatic plants can successfully compete with weeds (Weller, 1986). Besides, weeds could pollute essential oils mixing themselves with flowered stems at harvesting. Because of the particular use of MAPs, new agronomical techniques alternative to the use of chemical products for fertilization and weed control are required. The use of black plastic mulches could provide weed control while possibly improving crop growth. Experiments on herbs demonstrated that, as regards rosemary, plants grown on bare ground with no herbicide were less vigorous than when grown on plastic with herbicide (Ricotta and Masiunas, 1991); moreover, in many crops plant vigor, growth and yield were enhanced by paper mulching (Runham and Town, 1998).

The aims of the project were to verify the possibility of growing lavender (*Lavandula officinalis* Chaix) and rosemary (*Rosmarinus officinalis* L.) in a profitable way in the Sacra Valley (northwestern Italy); to control weeds by mulching, comparing this technique to an undisturbed situation, and to analyze the durability of the different black mulches used.

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MATERIALS AND METHODS

In the present work results of the first year of activity are reported. The experimental site is located in Castellamonte, settled in northwestern Italy, at an altitude of 400 m on a loamy soil. Two species were tested: lavender and rosemary, settled in two different experiments. In each experiment four mulching treatments were used: 1) control, with no mulch; 2) black polyethylene mulch, commonly used in horticulture; 3) black polypropylene transpiring mulch (type 'BKPPS10N', 0.45 mm thick, 100 g m^{-2}), and 4) black polypropylene draining mulch (type '2016', 0.35 mm thick, 100 g m^{-2}), the last two produced by Poirino Ltd. (Buttigliera, Asti, Italy). After soil tillage, mulches were laid in strips to cover the whole plot and then anchored using U-shaped wire pins. Two-year plants of lavender and rosemary grown in pots by "Lamparelli Nursery" (Revigliasco, Torino, Italy) were planted into holes punched into the mulches on 31 May 2001. Sixteen plants for each species were arranged in each plot in a grid spaced 0.6 m x 0.6 m, and provided with an overhead irrigation system of sprinklers; the entire plot was irrigated immediately after transplanting and then according to plant needs. The extremely heavy *Setaria viridis* L. Beauv. and *Echinochloa crus-galli* L. Beauv. infestation required hand-hoeing in the control plots and one application with glyphosate.

Periodical biometric sampling occurred during the growing season to study plant growth in the different mulching conditions (6 June, 3 August, 5 October). Lavender and rosemary canopy maximum height and diameter were measured, and lavender flowered branches counted. Weed checking was done 3 times throughout the season (13 July, 3 August, 15 September). Weed density was determined by the casual throwing of a square metallic grid (0.4 x 0.4 m) on the plots, counting the number of plants for each weed species. Mulch efficiency in weed control and mulch durability were evaluated for each treatment.

In each experiment, treatments (4 mulching levels) were arranged as a randomized complete block design with four replicates. The plant height and diameter values were subjected to the analysis of variance with repeated measures (Greenhouse-Geisser F-adjustments) (Greenhouse and Geisser, 1959; Huynh and Feldt, 1970; Littell, 1989; Nicola, 1997). Lavender flowered branches and weed density were subjected to univariate analysis of variance (4 treatments x 3 samplings x 4 blocks).

RESULTS AND DISCUSSION

Statistical analysis indicated a significative effect of the treatments over time, according to the analysis of variance with repeated measures. Plant height and diameter of lavender were significatively affected by the treatments over time (Table 1). Lavender was shortest in the control plot than in the other treatments (201 mm); and plants mulched with the draining mulch reached a similar height (205 mm); (Figure 1). The best results were obtained with polyethylene and transpiring mulches both in terms of height (218 and 212 mm respectively) (Figure 1) and diameter (206 and 198 mm respectively), while with the draining mulch plant diameter developed less (184 mm) (Figure 2). At the end of the growing season lavender plants in the control plots produced a number of flowered stems significatively lower (11 flowers) than plants in mulched plots (ca. 61 flowers) (Figure 3).

Rosemary diameter was significantly affected by the treatments over time, while rosemary plant height was not (tab. 2), but height was statistically influenced by the treatments themselves (P=0.001). In fact, rosemary differed more than lavender treatment effects: height increased statistically more with polyethylene mulch than with the others, while the worst results were given by the draining mulch. Maximum height and width were registered respectively in plants grown with transpiring (491 mm) and draining mulches (267 mm) (Figure 4 and 5).

The highest values of weed density were assessed in September in the control plot (406.3 plants m^{-2}); the decrease between the first and the second sampling is due to the treatment with glyphosate (Figure 6). Among the species sampled (Table 3), *Setaria viridis* and *Echinochloa crus-galli* had the highest density in the control plot (Table 4), while the draining mulch had these two species plus a significant amount of *Portulaca*

oleracea (Table 5).

Efficiency in weed control was different among the tested mulches. The polyethylene and transpiring mulches controlled 100% weeds; after five months from the starting of the experiment they remained intact, with no visible deterioration, thus providing the most effective weed control (Figures 7, 8, and 9). On the contrary, since from the beginning the draining mulch was perforated by some weed species (*viridis, crus-galli* and *oleracea*), which covered about 50 % of the mulch at the end of the growing season (Figures 6, 10 and Table 5).

The results showed that mulching was necessary to increase the growth of plants in terms of height, width and production of flowered stems, and to limit the development of weeds. Best results were obtained in lavender with polyethylene mulch in regards to both plant height and diameter; flowered stems did not require a specific mulch; on the contrary, growth of rosemary was augmented by transpiring mulch. Draining mulch was less effective in controlling weed expansion in comparison with polyethylene and transpiring mulches; mechanical and chemical control was not enough to contain weed diffusion.

CONCLUSION

In the first year of the experiment the best results in terms of lavender and rosemary growth and of weed control were achieved with polyethylene and transpiring mulches.

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The Authors have equally contributed to the research and to the manuscript.

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Tables

Table 1. Univariate analysis of variance and G-G adjustments of repeated measures for lavender plant height and diameter.

	Plant height				Plant diameter			
	Univariate		G-G		Univariate		G-G	
Analysis over time	DF	F Test	DF	Adjust.	DF	F Test	DF	Adjust.
Time	2	0.001	1.866	0.001	2	<0.001	1.657	<0.001
Time x Block	6	0.099	5.597	0.105	6	0.433	4.970	0.425
Time x Treat.	6	0.021	5.597	0.024	6	<0.001	4.970	<0.001
Error	448		417.929		448		371.109	

Table 2. Univariate analysis of variance and G-G adjustments of repeated measures for rosemary plant height and diameter.

	Plant height				Plant diameter			
	Univariate		G-G		Univariate		G-G	
Analysis over time	DF	F Test	DF	Adjust.	DF	F Test	DF	Adjust.
Time	2	<0.001	1.309	<0.001	2	<0.001	1.520	<0.001
Time x Block	6	<0.001	3.927	<0.001	6	0.028	4.559	0.043
Time x Treat.	6	0.332	3.927	0.333	6	0.010	4.559	0.018
Error	294		192.442		294		223.374	

Table 3. List of weeds present in the crop.

Agropyron repens (L.) Baeuv.	*Polygonum persicaria* L.
Amaranthus retloflexus L.	*Portulaca oleracea* L.
Artemisia vulgaris L.	*Potentilla* sp.
Chenopodium album L.	*Ranunculus* sp.
Digitaria sanguinalis (L.) Scop.	*Rumex acetosa* L.
Echinochloa crus-galli (L.) Beauv.	*Setaria viridis* (L.) Baeuv.
Euphorbia sp.	*Solanum nigrum* L.
Galinsoga ciliata (Rafin.) Blake	*Taraxacum officinale* Weber
Oxalis europaea Jordan	*Trifolium pratense* L.
Picris sp.	*Veronica persica* Poiret
Plantago lanceolata L.	*Vicia* sp.
Polygonum aviculare L.	

Table 4. Weed density (number of plants m^{-2}) during the growing season in the untreated plot (control).

	Control		
Species	13 Jul.	3 Aug.	15 Sep.
Setaria viridis (L.) Baeuv.	170.3	104.7	331.3
Echinochloa crus-galli (L.) Beauv.	57.0	14.1	26.6
Veronica persica Poiret	27.3	9.4	0.0
Portulaca oleracea L.	26.6	46.9	4.7
Agropyron repens (L.) Baeuv.	25.0	3.1	4.7
Digitaria sanguinalis (L.) Scop.	10.2	7.8	14.1
Polygonum persicaria L.	5.5	3.1	0.0
Trifolium pratense L.	4.7	0.0	0.0
Chenopodium album L.	3.9	26.6	6.3
Potentilla sp.	3.1	10.9	0.0
Others	7.0	15.6	18.8

Table 5. Weed density (number of plants m^{-2}) during the growing season in the plot treated with the polypropylene draining mulch.

	Draining mulch		
Species	13 Jul.	3 Aug.	15 Sep.
Echinochloa crus-galli (L.) Beauv.	4.7	0.0	4.7
Portulaca oleracea L.	0.8	0.0	6.3
Setaria viridis (L.) Baeuv.	0.0	0.0	25.0
Veronica persica Poiret	0.0	0.0	3.1
Agropyron repens (L.) Baeuv.	0.0	0.0	4.7
Digitaria sanguinalis (L.) Scop.	0.0	0.0	3.1
Polygonum persicaria L.	0.0	0.0	4.7
Chenopodium album L.	0.0	0.0	7.8
Others	0.0	0.0	15.6

Figures

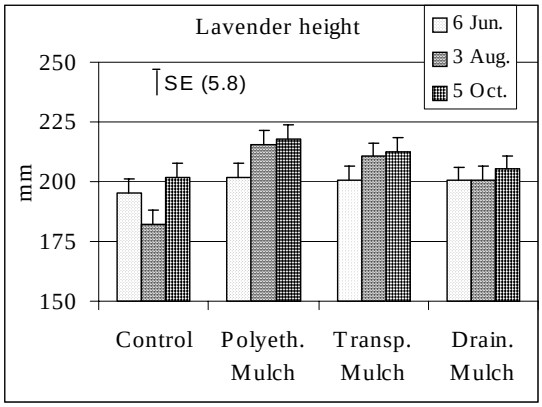

Fig. 1. Lavender canopy height in the different treatments during the season.

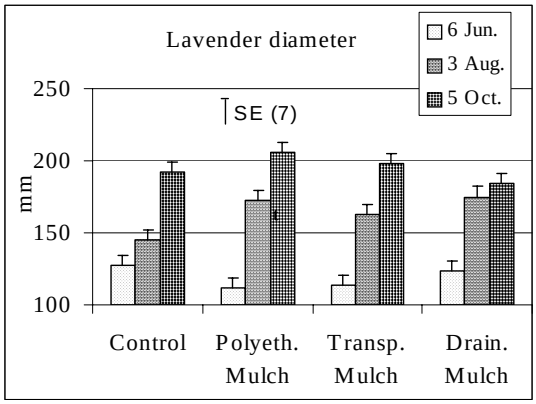

Fig. 2. Lavender canopy diameter in the different treatments during the season.

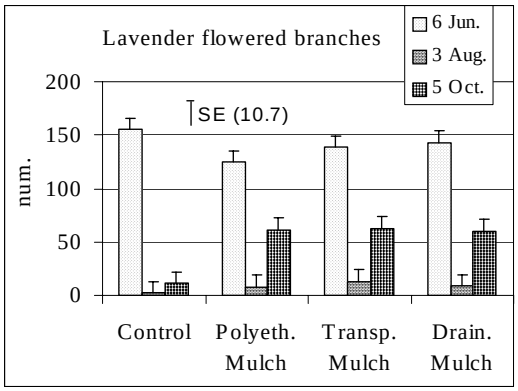

Fig. 3. Number of lavender flowered branches in the different treatments during the season.

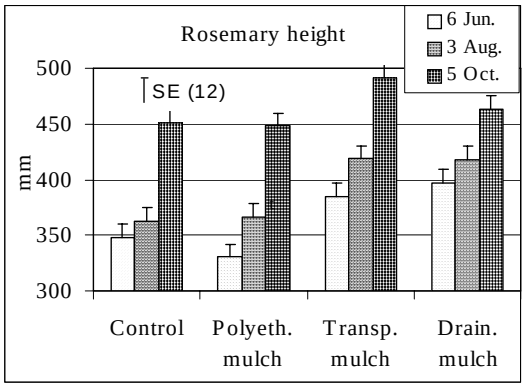

Fig. 4. Rosemary canopy height in the different treatments during the season.

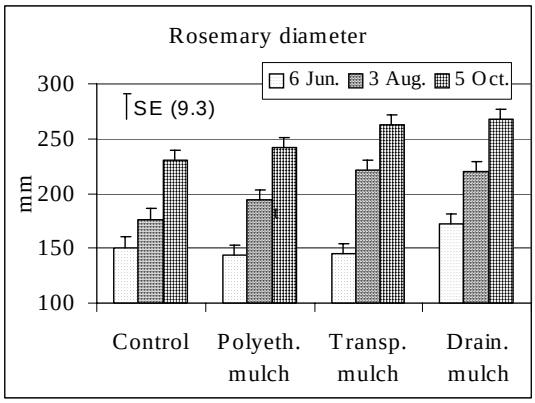

Fig. 5. Rosemary canopy diameter in the different treatments during the season.

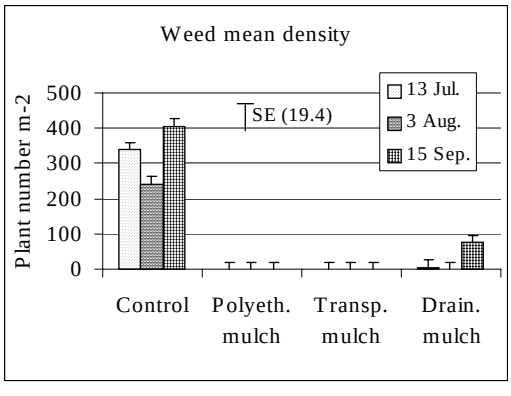

Fig. 6. Weed mean density in the different treatments during the season

Fig. 7. Plants growing without mulch (control).

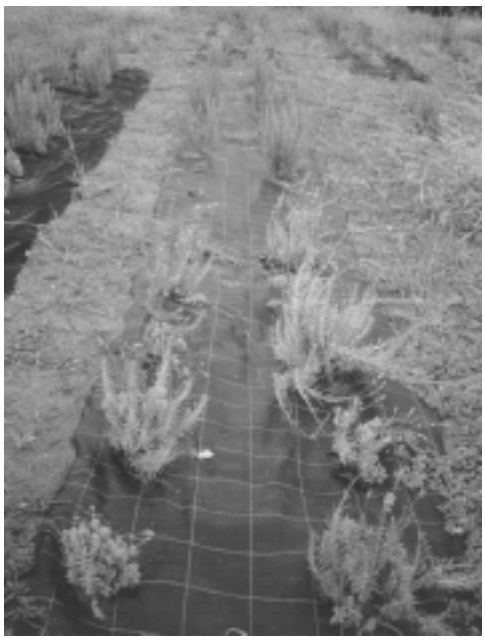

Fig. 8. Plants growing with polyethylene.

Fig. 9. Plants growing with transpiring mulch.

Fig. 10. Plants growing with draining mulch.