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Professional paper

THE STUDY OF THE IMPACT OF SOIL LIMING ON THE MORPHOLOGICAL AND PRODUCTIVE INDICATORS OF SAGE (*SALVIA OFFICINALIS L*) IN THE SECOND YEAR OF THE EXPERIMENT AND THE CORRELATIONS BETWEEN THEM

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Abstract

Sage (*Salvia officinalis L*) is the most widespread medicinal plant in Albania and which ranks first for export among aromatic and medicinal plants. It extends almost across the entire Albanian territory, being represented by morpho-biological and chemical variations depending on the soil and the areas of extension. For the economic interest it has had and continues to have, it is cultivated in some areas of Albania and mainly in the stony soils of Koplik. The chemical composition of the herb depends greatly on the chemical composition of the soil and the climatic and soil conditions. The essence content varies depending on the climatic and soil conditions and ranges from 2.6% contained in the sages of the southern part of Albania to 3.8% and rarely 4.1% of the sages in the northern part of Albania. The content of calcium carbonate (CaCO3) affects the morphological indicators, production, and chemical composition of sage herb. Precisely, to determine this influence, a field study was undertaken on sage development rate and essence content. The experiment was set up with four variants and four repetitions. The variants are: V1= no liming, V2= 40 kv/ha lime, V3= 80 kv/ha lime and V4 = 120 kv/ha lime.

Keywords: ariant, sage, indicator, lime, essence, and yield.

1. INTRODUCTION

Sage is the most important medicinal plant with a wide spectrum of uses. It requires a lot of calcium carbonate (lime) which affects the increase of the essence content. This study also aims to study the impact of soil liming on morphological indicators, production and essence content in sage.

Scientific methodology - It includes four variants: V1 - 0 kv/ha, V2 - 40 kv/ha, V3 - 80 kv/ha, and V4 - 120 kv/ha. The lime ground in powder form was used. The surface area of the variant was 60 m2 (10 m X 6 m) planting 10 rows per variant providing 330 plants /variant or 55 000 plants /ha.

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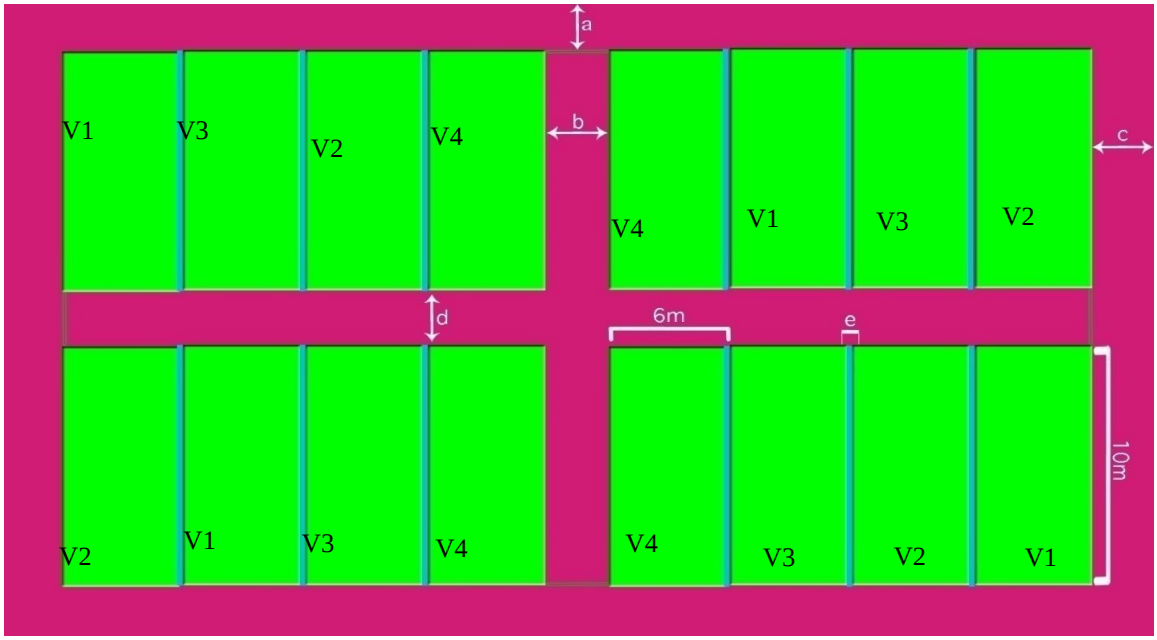

Scheme No. 2. Setting up the experiment to study the effect of soil liming on the sage plant.

Before starting the experiment, soil analyses were done: water pH 6.95, saline pH 6.7, Humus 2.2%, Nitrogen 0.14%, Phosphorus 11.6 mg/ 100 g soil, Potassium 13.27 mg 100 g soil, CaCO3 1.64 %. The lime is poured before the final milling. The ecotype of Dibra is included in the study. The seedlings were planted in 2021 and the data of 2022 or the second year of cultivation were obtained. The seedlings were produced in solar greenhouses in Lushnja. The planting in the field was done on April 5, 2012. In the second year (in 2013), two mowings were carried out, the first on June 5-10 and the second on September 5-10. 40 plants were pre-selected (in all 4 repetitions with 10 for each variant) in which biometric measurements were made during the vegetation, as well as in the production harvest. Measurements and calculations were made for the morphological and productive indicators as follows:

1. Number of shoots/plant.
2. The height of the plant.
3. The length of the sprout (shoot).
4. The leaf length.
6. The leaf width.
7. The length of the petiole.
8. Number of leaves/plant.
9. Content of shoots in the herb (%).
10. The yield of the first mowing.
11. The yield of the second mowing.
12. Annual yield (first mowing and second mowing).
13. Coefficients of correlations between indicators.

Measurements of plant height (main stem), leaf length, leaf width, petiole length, number of shoots (stems) per plant, and number of leaves per shoot were performed on a representative sample of 40 plants (4 x 10 plants/variant in each replicate), randomly selected for each variant and each replicate, which were tagged with stationary tags throughout the study period. The measured data were recorded and analyzed and the average value was calculated for each indicator.

The basic soil tillage was done in the first year (August 2010) at a depth of 31-35 cm and in the spring the preparatory tillage was done at a depth of 26-30 cm. In March of the second year, treatment was done with Focus Ultra to fight weeds using 3 liters/ha of the preparation,

dissolved in 400 liters of water. The spraying was done on April 10, when the plants were in full vegetation.
During the vegetation, the following services were provided: Irrigation and fertilization with liquid organic manure for sheep and goats. No chemical fertilizers were used either in the basic fertilization or in the supplementary fertilization.
Statistical analyses: The data obtained were analyzed using statistical analysis of variance, ANOVA and differences between variants were tested using the least significant difference (DMV) test (0.05 and 0.01) (Papakroni, 2001).

2. Results and discussion of second-year data

During the second year, two harvests were made, the first on June 5-10 and the second on September 5-10. After harvesting, drying was done, first (3 days) in the shade and then in the sun until the humidity reached 12%. Weightings were made for each variant and corresponding calculations were made.

Table 1. Effect of different doses of soil liming on sage plant height.

No.	Variants	Repetitions				Average
		I	II	III	IV	
1	0 kv Lime	77	79	78	78	78
2	40 kv/ha Lime	81	83	84	81	82.25
3	80 kv/ha Lime	84	84	86	85	84.75
4	120 Kv/ha Lime	87	88	87	89	87.75**
	Average	82.25	83.5	83.75	83.25	

Dmv: 0.05 = 1.97 0.01 = 2.43

Sage height is an indicator of interest in sage yield and herb quality. Often the number of leaves per plant depends on the length of the shoot, so it is evaluated in the morphological indicators. This is excluded in cases where the plants do not develop under normal light conditions, so they are etiolated and the leaves are rarer. The plants of the fourth variant have the greatest height, for both levels of authenticity, i.e. with 120 kv/ha of lime. This shows the influence of lime on the normal growth of the sage plant.
The number of shoots is an indicator that affects the yield of sage herb and especially the ratio between shoots and leaves.
The results of this study show that the number of shoots depends on the amount of lime in the soil. Between the variants, there are statistically proven differences for both levels of authenticity and precisely the variants with higher values are the last two variants, i.e. with doses of 80 and 120 kv/ha of lime, variants that also give the highest yield of grass and leaves
The sage sprout is the organ that in general practice is harvested. It should have 7 – 11 leaves (the harvested bouquet). Its length cannot be simply linear. There is a harmonization of its length. In the concrete case, it results that the third variant has a difference for one level of authenticity and the fourth variant for both levels of authenticity. The length from 12 cm to 15 cm is considered more suitable for the quality of the herb, having a fairer combination between the length and the thickness of the shoot.
The width of the leaf also follows the same rules as the length of the leaf but with smaller sizes and changes. In this perspective, we will assess that these two factors are decisive in the quality of the leaf and in the yield of the sage. The herb composed of 100% leaves is of the highest quality and is used in cosmetics and for quality medicinal teas. There are no statistically proven changes and it is a non-changing indicator. During the preparation of medicinal teas, they are removed and can be used with low-quality herbs for the production of sage essence.

The number of leaves per plant is the final indicator for yield and a number of other chemical indicators for different use values. The progress of the influence of soil liming doses on the number of leaves is sensitive. The two variants with higher doses of liming also present the highest values of the number of leaves. They directly correlate with herb yield and quality. The number of leaves with its elements, length and width determine not only the quality of sage but also the purpose of use.

Usually, the processing of sage, it is aimed to remove foreign matter, the residues of other plants, as well as stalks of sage, which do not have qualitative and quantitative values of their essence and components. Before it goes to the processing industry for cosmetics, medicine and the food industry, the herb is cleaned from all its stems and parts. In price policies, the indicator of the content of the stems is very decisive. Suffice it to mention that the herb not cleaned from the stems is bought for 180-220 ALL/kg, while the pure leafy herb is bought for 350 ALL/kg. Often in international marketing from the processing of the herb, its purification, an added value of over 20% of the initial value of the herb is achieved. Already in the European and American market there are great demands for the purity of the herb and its quality. This is clearly evidenced in setting standards according to some indicators.

Table 2 Average one-year data of morphological indicators.

No.	Liming	Indicators				
		Number of shoots/plant (cm)	The height of the plant (cm)	Harvested shoot length (cm)	Leaf length (cm)	Leaf width (cm)
1	0 kv/ha Lime	27.83125	76.875	10.1025	6.41625	1.8
2	40 kv/h Lime	31.0	80.375	10.7125	7.33475*	2.04375
3	80 kv/ha Lime	34.075	82.5	11.48625	7.4765**	2.25625
4	120 kv/ha Lime	36.675**	85.4375**	12.10625**	7.73625**	2.50625**
5	Dmv 0.05	1.342	1.671	0.452	0.316	0.0364
6	0.01	1.827	2.103	0.635	0.473	0.0615

The number of shoots per plant, the height of the plant, and the length of the harvested shoot are at higher levels in the fourth variant, i.e. with a liming dose of 120 kv/ha. Likewise, the leaf width is higher in this variant for both levels of authenticity. The length of the leaf almost does not present changes due to the change of liming doses.

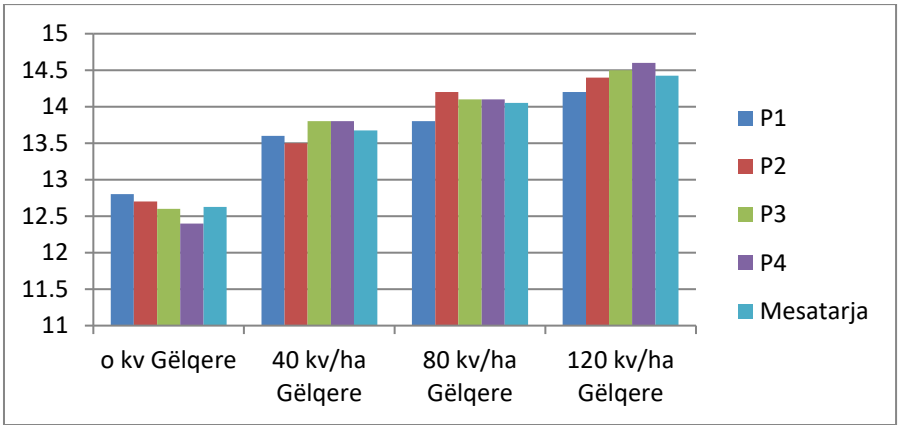

Chart 1 The effect of soil liming on the number of leaves / plant in sage.

The number of leaves per plant is the most important indicator that affects the quality of the herb and the yield of sage.

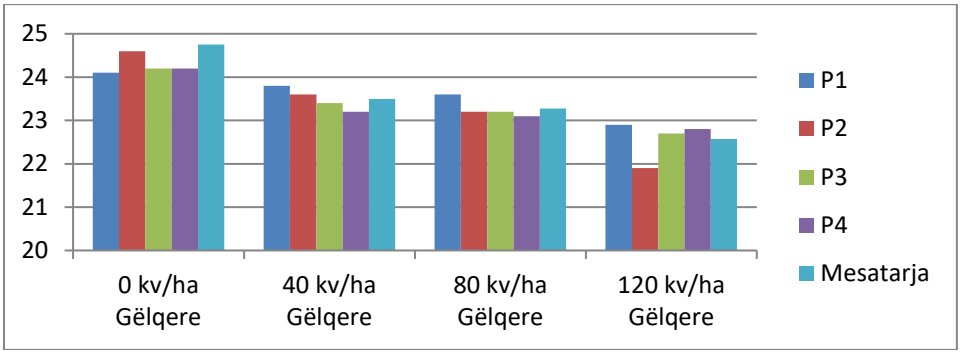

Chart 2 The influence of soil liming on the content of stems in herb.

The stem content is the indicator that is often evaluated both technically and commercially and determines the quality coefficient after cleaning the grass. The lower this indicator, the better the herb. This indicator depends on the cultivation technology and the method and time of harvesting the plant. In the second year, there are higher values because the plants are more developed and especially the cellulosic shoots are more and earlier.

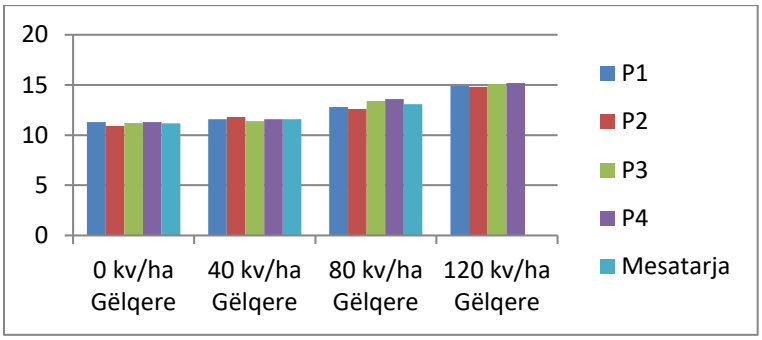

Chart 3 Effect of soil liming on sage yield. The first mowing.

The herb yield for the first mowing is different in years as well as between doses of soil liming. For the second year, the two variants with higher liming doses have the highest yield for both levels of authenticity.

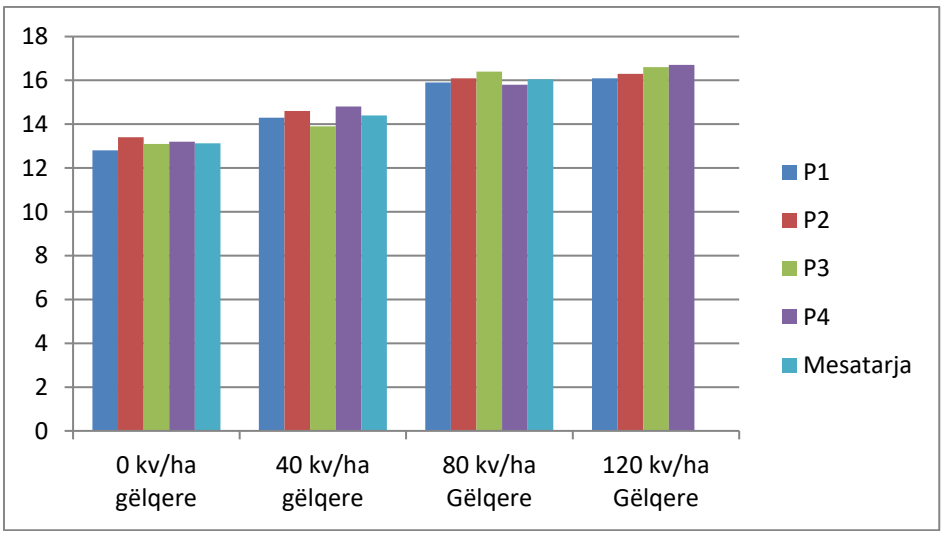

Chart 4 Effect of soil liming on sage yield. Second mowing

In the second year, two mowing were taken, respectively in June and September. A higher yield was obtained from the second mowing than from the first mowing. In fact, the two variants with higher doses of soil liming are more productive.

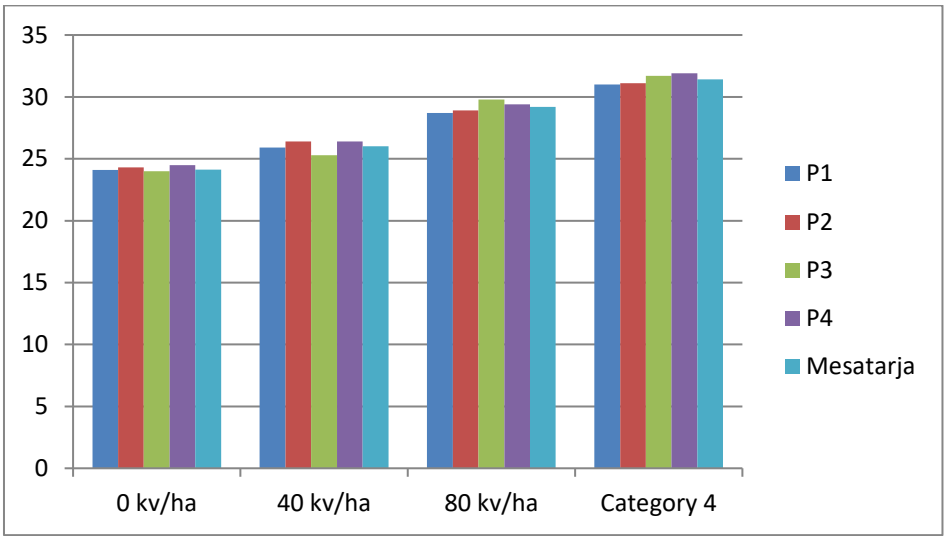

Chart 5 Effect of soil liming on sage yield. Mowing I +II.

The comparison of the data shows that in the second year, the highest yield is achieved in the variant with 120 kv/ha of lime. From the average of the data, it results that both variants with higher doses of soil liming are better for both levels of authenticity.

The analyzed indicators are interrelated and affect the yield of sage to different degrees. The number of shoots has a moderately strong relationship with yield (0.79) indicating that it is not decisive in the final yield of sage. Plant height has a lower influence on sage yield with a non-strong correlation coefficient (0.68). The number of leaves/plant presents the main influence on sage yield. It has a very high coefficient (0.89), the highest of all other indicators. Seen from this point of view is the factor that completely determines the yield and quality of sage. The other two leaf parameters, length and width, show weak relationships with yield and relatively well affecting herb yield.

4. Conclusions and recommendations.

The impact of soil liming is high and statistically proven for morphological and productive indicators in sage. From the general analysis of all indicators we can draw some conclusions:

1.Increasing doses of soil liming affects the morphological indicators of sage: Number of shoots, plant height, leaf length and leaf width. The highest indicators are achieved at doses of 80 and 120 kv/ha of lime.

2. The leaf petiole length indicator is not affected by increasing doses of soil liming.

3. With increasing doses of liming, the number of leaves per plant increases, influencing the increase in yield and improving the quality of the herb.

4. The effect of increasing liming doses is clearly felt in the yield according to the mowing and in the final yield, too. Higher yields are achieved in variants with high doses of soil liming.

There are different relationships between morphological indicators and the yield of sage. The strongest links are between the yield and the number of leaves, which also plays a role in determining the production of the herb and its quality.

Based on the results obtained from this study, we can recommend liming the soil with doses of 80 and 120 kv/ha of lime, which affects not only the increase in yield but also the increase in

the productive life of sage. In the variants with liming at doses of 80 and 120 kv/ha of lime, there is a higher number of plants in the third and fourth year (the experiment on the longevity of the sage plant carried out in plots in Cerrik of Elbasan).

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