

IMPACT OF SOIL CALCIFICATION TO THE MORPHOLOGICAL AND PRODUCTIVE INDICATORS OF SAGE

Qatip DODA¹, Nikollaq BARDHI², Bujar ZEKA³, Agim RAMETA⁴, Dilaman NELAJ⁵, Nefrus ÇELIKU⁶

¹Agriculture Directory of Dibra, Prefecture of Dibra, Albania

²Agricultural University of Tirana, Albania

³Agriculture Directory of Berat, Prefecture of Berat, Albania

⁴Agriculture Directory of Durres, Prefecture of Durres, Albania

⁵Agriculture Directory of Kukes, Prefecture of Kukes, Albania

⁶Ministry of Agriculture, Forestry and water Economy, Republic of Macedonia

*Corresponding autor: bardhi.nikoll@yahoo.com

Abstract

Sage (*Salvia officinalis* L.) is the most important medicinal plant in Albania (Ahmetaj, H. & Çeku, K. 1988; Albanian Research Institute for Forests and Pasture (ARIFP). 1988; Bardhi, N. 2008; Demiri, M. 1971; Hyso, M., Çobaj, P. 2005; Paparisto, K., Demiri, M., Mitrushi, I., Qosja, Xh. 1988), as from the natural surface, and as from the cultivated surface, too. Albanian production of sage is the most demanded in international markets. (Clebsch, B., Barner, C. D. 2003; Marko, O., Dishnica, T. 2002; Ndoja, H. 2001) Suffice it to mention that over 42% of sage consumed in the U.S. is imported from Albania. In the recent years, it has been increased the demand for production of sage, (Lorraine, H. 2012; George, E. F. 1996) and therefore increasingly it is cultivated even more being subsidized by the Albanian government. Moving from the natural growth to the cultivated growth, there are been arise problems, regarding the chemical composition of herbs under the influence of cultivation technology (Kintzios, S. E. 2000; Kongjika, E., Zekaj, Zh., Çausi, E. & Stamo, I. 2002). Sage is highly influenced by the presence of lime in the soil, as for the production, for its longevity, and especially in the chemical composition of the herb (Asllani, U. 2000; Asllani, U. 2002; Akhondzadeh, S., Noroozian, M., Mohammadi, M., Ohadinia, S., Jamshidi, A. H., Khani, M. 2003). Given the fact that the value of sage essence lies in the content and its chemical constituents (Kongjika, E., Zekaj, Zh., Çausi, E. & Stamo, I. 2002; Lorraine, H. 2012), the experiment was set up to study the impact of lime on the morphological indicators, the productive indicators, chemical composition and the correlations between them. In this reference will be presented the data for morphological and productive indicators, chemical composition and correlations between them. There were been included four variants of study with doses of calcification: 0 quintals / ha, 40 q / ha, 80 q / ha and 120 q / ha. The lime is been spread on the soil before the last soil preparation process (milling).

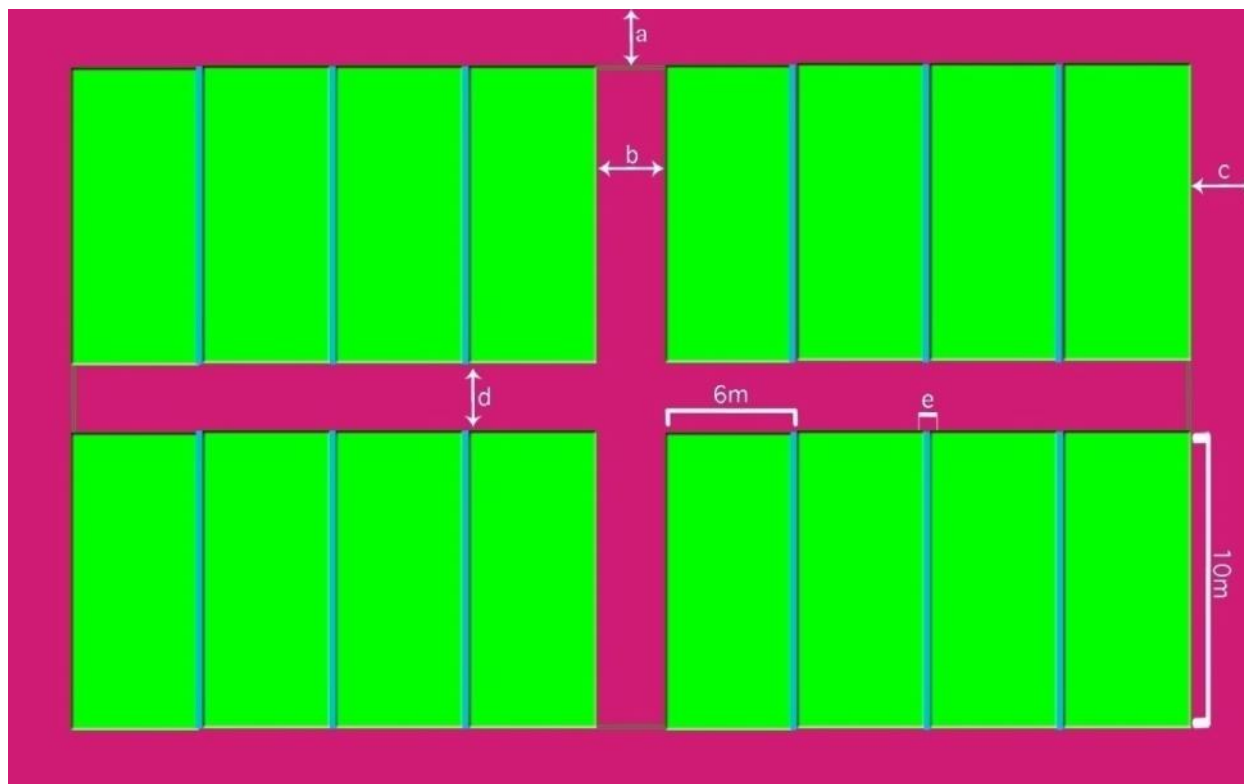
Key words: *Sage, morphological indicators, yield, cultivation, condition, ecotype, herb.*

Introduction

Sage is highly influenced by the presence of CaCO_3 in the soil, as for the production, as well as to chemical composition and the content of the essence. Given the fact that the value of sage lies in the content of the essence and its constituents, the experiment was set up to study the impact of lime on the morphological and the production indicators, and the chemical composition of the sage essence. The study included four variants: 0 quintals / ha, 40 q / ha, 80 q / ha and 120 q / ha of ground and powder lime. The lime is been spread before last milling.

Material and methods

It includes four variants: 0 quintals / ha, 40 q / ha, 80 q / ha and 120 q / ha of ground powder lime. Variant size was 60 m² (10m x 6m), by planting 10 rows for each variant, providing 330 plants / variant or 55,000 plants / ha. In the experiment are four variants, included in four repetitions, according to randomized block scheme.



Scheme No.1 Setting up the experiment to study the impact of land calcification

Before the establishment of the experiment were made the soil analysis: water pH 6.95, salt 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 distributed before last mowing. In the study are included ecotypes of Dibra region. Seedlings are produced in solar greenhouses, in Lushnja region. The planting in the field is made in 5 April 2010. In the first year is realized only one mowing, the first in 10 -12 September, and the second 5-10 September, while in the other three years were taken two mowing, the first in June 5 to 10 and the second in 5-10 September. 40 plants are selected (4 repeats of 10 plants each), in which the biometric measurements were made. During the vegetation and the production harvesting and the measurements and calculations were made for morphological and production indicators, as follows:

- The number of shoots/plant
- The height of plants
- The length of shoots
- The length of leaves
- The width of leaves
- The number of leaves/plant
- The contain of shoots in herbs (%)

The yield of the first mowing

The yield of the second mowing

Annual productivity (first and second mowing)

The correlation coefficients between the indicators.

Measurements for the height of the plant (main stem), leaf length, leaf width, leaf length of the tail, the numbering of the shoots / stalks per plant and number of leaves per shoots were conducted in a representative sample of 20 plants selected in order random for each variant, in each repetition. These were labeled with stationary labels throughout the study period. The measured data were recorded, analyzed and the average value was calculated for each variant and four-year average.

Statistical analysis. The data obtained were analyzed using statistical analysis of variance, ANOVA, and differences between variants were tested using LSD test (0.05 and 0.01). (Papakroni, 2001)

Results and Discussion

Average data from four years of the study show that there are differences in morphological indicators statistically validated.

Table 1. The four-year average data of morphological indicators

No	Indicator					
	Calcification	Number of shoots/plant	Plant height (cm)	Height of harvested shoots	Leaf length (cm)	Leaf width (cm)
1	0 q/ha lime	27.83125	76.875	10.1025	6.41625	1.8
2	40 q/ha lime	31.0	80.375	10.7125	7.33475*	2.04375
3	80 q/ha lime	34.075	82.5	11.48625	7.4765*	2.25625**
4	120 q/ha lime	36.675**	85.4375**	12.10625**	7.73625**	2.50625
LSD 0.05*		1.342	1.671	0.452	0.316	0.0364
LSD 0.01**		1.827	2.103	0.437	0.473	0.0615

The number shoots for plant, plant height and length of shoots were harvested at higher levels in the fourth variant, ie dose of calcification 120 quintals / ha. Similarly, the width of the leaf is higher at this variant for both probability levels. The length of the leaf, almost isn't changed by change of the calcification dosage.

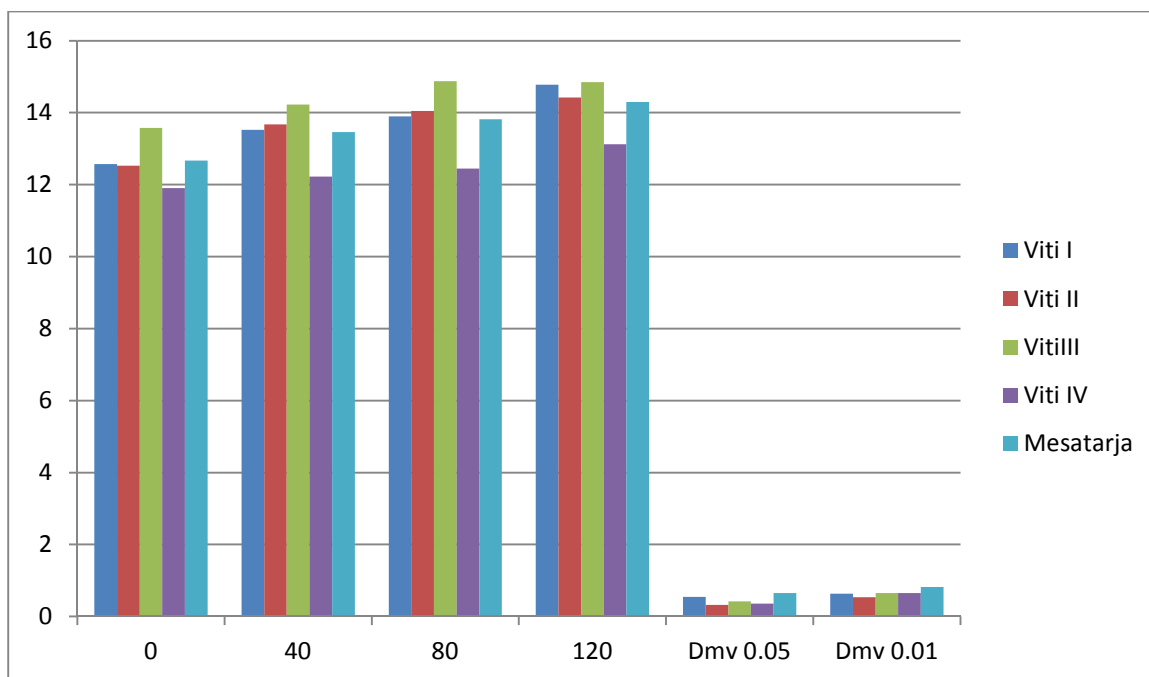


Figure 1. The impact of soil calcification in the number of leaves

The number of leaves per plant is the most important indicator that influences the quality of herb and the yield of sage. In the first year there is a high number of leaves in the fourth variant. Likewise, even during the second and third year, are been presented with the highest values of two last variants. The fourth year has the lowest value in all variants compared with the other years, and again the fourth variant has the higher values. The average of four years results that the variants with 80 and 100 q / ha lime show the impact of increasing doses of lime in the number of leaves.

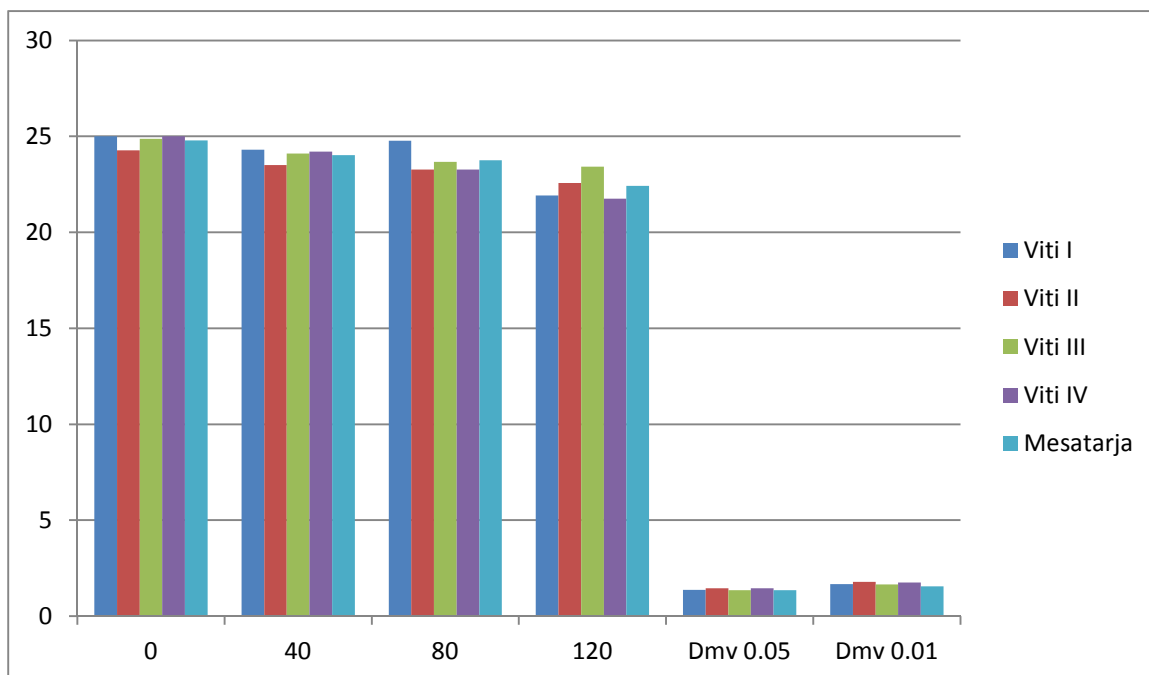


Figure 2. The impact of soil calcification on the content of stalks in the herb

The stalk content is the indicator that often is evaluated as in the technical aspect, but also in the commercial aspect that determines the quality coefficient after cleaning the herb. How to be lower this indicator, the better will be the herb. This indicator is depended on the technology of cultivation the way and time of the plant harvesting. In the first and fourth years, the values are lower because the plants are less developed, while in the second and third year, the values are higher because plants are more developed and especially, the stalks create the cellulose more and earlier. For four years (each separately), as well as four-year average, the variant with 120q/ha results in lower content of stalks, for both probability levels, and the variant 80 quintals / ha for one probability level.

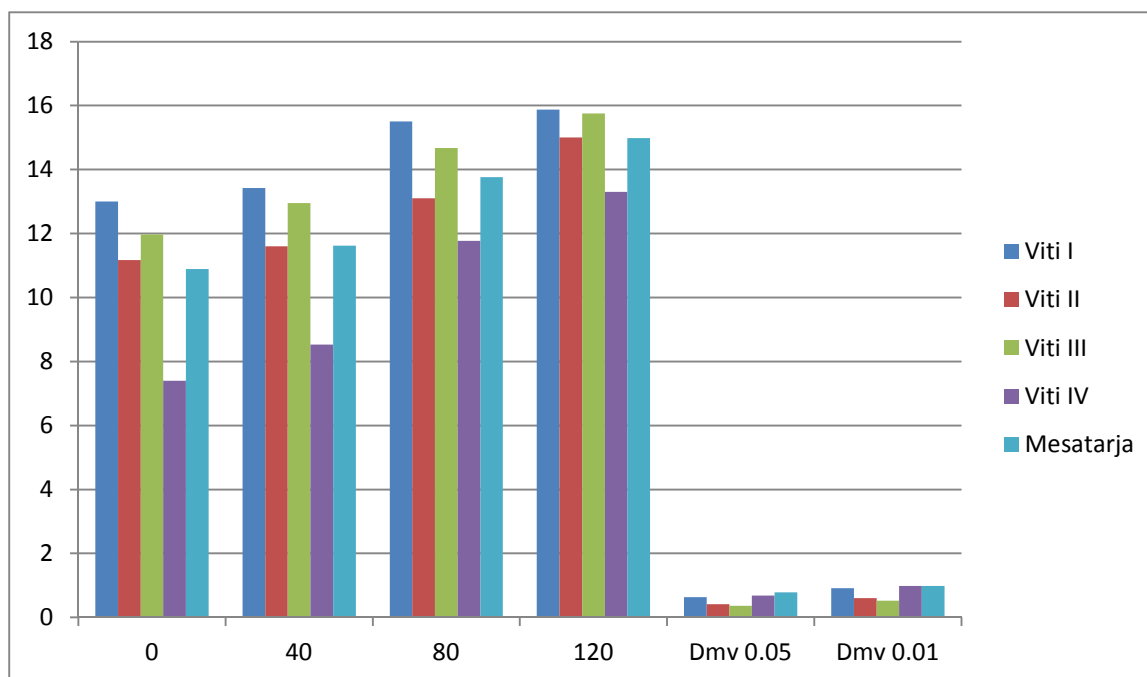


Figure 3. The impact of soil calcification in the sage yield. The first mowing

The herb yield for the first mowing is different during the years and between doses of soil calcification. In the first year, the highest yield is observed at two variants with the highest doses of soil calcification, for both probably levels. For the three other three years results the variants of 120 q/ha lime for both probably levels, but the fourth year, generally, has the lowest values, and the difference is greater in the lower doses of soil calcification. Clearly, this shows that the lime significantly affects in avoidance of the sage degradation. In the first variant without lime it is observed that the yield is lowered about 50%, and for other years gradually is decreased. In the fourth year, the yield is lowered only 8-10%. This is the reason why to soils with high content of lime, or lands with calcification, sage can live up to five years

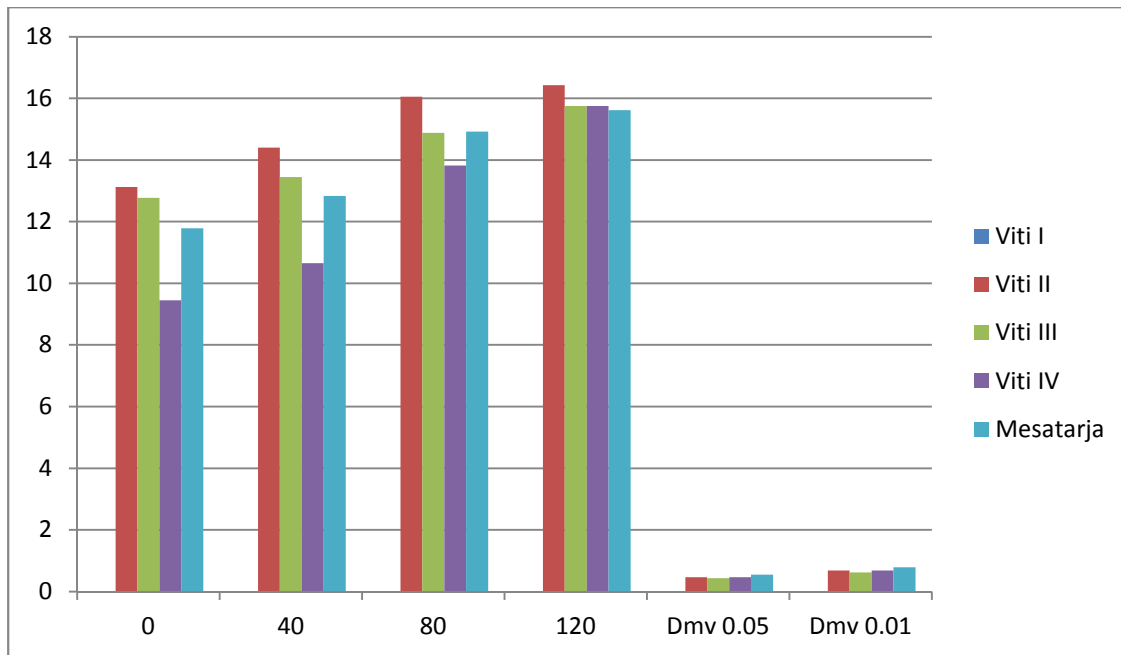


Figure 4. Impact of the soil calcification in the yield of sage. The second mowing

In the first year is harvested only one mowing which is usually taken later than the first mowing of the next years and earlier than the second mowing of the next years. This is done in order to the plant to winter with a fully formed bush and the shoots to form much buds. In the second year it is received a higher yield by the second mowing than in the next years. Actually, two variants with higher doses of calcification of the soil have the highest yield. In the third and the fourth years it is a close in performance, and the variant of 120 q/ha lime has given the higher productivity for both years. The average of four years show that the variant with 120 q / ha has given the highest yield for the two probably levels, and the variant with 80 q / ha only to one probably level.

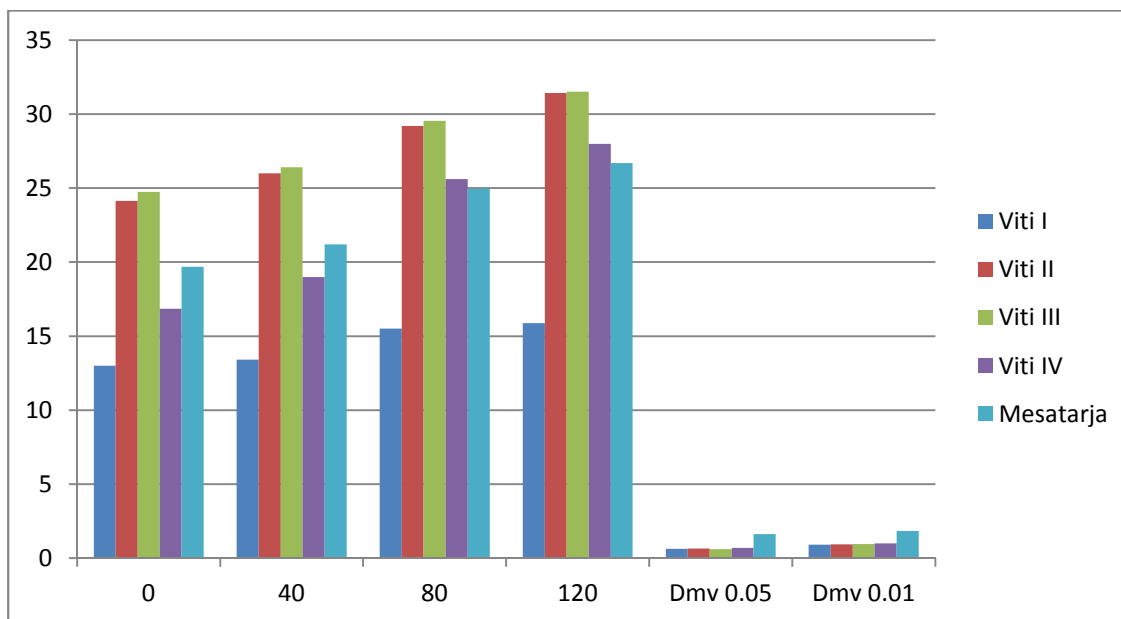


Figure 5. The impact of soil calcification in the sage yield. The mowing I+II

In the four-year cultivation of sage there are been achieved the high yields in the production of herb and its quality. By comparison of the data it is resulted that in the second, third and fourth year, the highest yields is achieved in the variant with 120 q / ha lime. From the four-year average is resulted that two variants with higher doses of the soil calcification, for both probably levels are the best. The performance over the years of the total yield of sage appear higher level in the second and third years, with over 30 quintals / ha, but in the fourth year is decreasing to 4 quintals / ha compared with the average of the second and third year. This is why, in many cases it is required that sage to be held in cultivation even in the fifth year, bringing failures to income because it often has significant reduction in productivity of the fifth year.

Table 2. The correlation coefficients between characteristics under the influence of soil calcification.

No.	The characteristics	The yield	Number of stalks	Height of plant	Number of leaves /plant	Leaf length	Leaf width
1	Yield	1					
2	Number of stalks	0.79	1				
3	Height of plant	0.68	0.58	1			
4	Number of leaves/plant	0.89	0.86	0.87	1		
5	Leaf length	0.71	0.75	0.85	0.92	1	
6	Leaf width	0.74	0.77	0.79	0.89	0.94	1

The analyzed indicators are linked between them and they influence in different scale in the performance of the sage. The number of shoots hasn't a strong connection with the yield (0.79), indicating that it does not appear decisive in the final yield of sage. The height of the plant represents a lower impact on the productivity of sage having a correlation coefficient not higher (0.68). The number of leaves / plant represents the main impact on the yield of sage. This indicator has a coefficient very high (0.89), so the highest coefficient of the other indicators. From this viewpoint, this is the factor that determines fully the yield and the quality of sage. Two other indicators of leaf, length and width, don't present a strong connection with the yield, affecting comparatively better in the herb yield.

Conclusions

The impact of soil calcification is high and statistically proven to morphological and productive indicators of sage. Between the morphological and productive indicators of sage there are strong qualitative relations. Based on the results obtained from this study, we may recommend the soil calcification with 80 and 120 q / ha lime. Meanwhile, it results that the soil calcification has affected the growth of productive lifetime of sage

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