# PARTIAL RESULTS REGARDING THE INFLUENCE OF CLIMATIC CONDITIONS ON THE QUALITY OF LAVENDER AND SAGE PRODUCTION

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***Abstract.*** *The influence of climatic conditions on the herbal production (kg/ha) and the essential oil content (%) obtained with twelve species of aromatic plants: lavender Lavanda angustifolia L.) and sage (Salvia officinalis L.). The climatic condition characterization was based on recordings of meteorological conditions found at the Arganda Meteorological Station, situated 6 km away from the experimental field in the locality Morata de Tajuña (40 13 46 N, 3 26 11 V), Madrid, Spain. The active principle content in the essential oil is higher in warm, dry areas (Racz, and Evdochia Coiciu 1970). Between certain limits, the high temperature, especially during the blooming period, leads to the synthetisation of all active principle categories. The warm weather favours the content and quality of volatile oils. When analysing the climatic conditions of the year 2015, one observes that, during the vegetation period form planting the biological material in the lot on October 10th until harvesting in July, a temperature degree sum of 530°C was calculated, which is considered optimal for the two aromatic crops. Also, the temperatures during the last 45 days before blooming, in April for sage and June and July for the lavender crops, were optimal for the accumulation of volatile oils in the plant. Aromatic plants usually require a warm climate with low precipitations. The critical stage for the water demand is during the period of vegetative growth, buttoning and blooming. If, during the previous months, the hydric input is sufficient, during the months when the aromatic plants bloom, they do not require much precipitation. The rains falling during the blooming and harvesting period will endanger the quality of the volatile oil. One may observe that the agricultural year (Spain) displays a normal climatology and does not differ significantly from the average. We may thus state, that the experimental field crops did not encounter any special problems. We must mention the fact that during the months of March, April, May and June, a water input of ca. 200l/m$^2$ was provided through irrigation.*

***Keywords****: italic climatic conditions, essential oil, production herbs.*

## INTRODUCTION

Sage is cultivated for the above ground part (*Salvia herba*), the obtained herba production showing values ranging between 660-944 kg/ha. The volatile oil content in dry herba, varies between 0.87 – 1.27 %. The essential oil quantity obtained from dry herba, in 2016 from *Salvia officinalis* L. ranged between 7.2 -8.4(l/ha).

Lavander is cultivated for the inflorescence (*Lavandulae flos*, *Lavandulae augustifoliae flos*, *Flores Spicae),* used in fresh or dry state. Fresh flowers contain between 0.7 – 1.4 % volatile oil, and, reported to the dry plant, it can reach 11.3 %. Part of the volatile oil is lost through drying (appreciated 35 - 47 %), so that dry flowers contain an average of 1.5 % volatile oil (U. STĂNESCU ET AL., 2001).

On the experimental field founded in the Morata de Tajuña locality, Madrid, Spain, the essential oil quantity acquired from fresh inflorescences, in 2016 with *Lavandulae augustifoliae flos* varies between 6.0 -10.8(l/ha), and the fresh inflorescence production ranged from 444 - 836 kg/ha.

Pedoclimatic conditions influence the volatile oil content as well as its chemical composition (MUNTEAN L.S. COLAB.2007).

The climatic data were taken over from the Meteorological Station Arganda situated 6 km away from the Morata de Tajuña locality, Madrid, Spain. The average annual temperature is of 14.4 °C, and precipitations reach 420 mm.

The climate is medium-Mediterranean. This bioclimatic step is characterised by frost of -5 °C to -8 °C, in winter, and high temperatures in summer, usually 35 °C, with days of 40 °C, and precipitations between 350 and 600 mm.

A drip irrigation system was installed, so that the hydric supply is the same with the hydric regime in the Banat area. In Spain, of the 2.3 thousand has cultivated with lavender, only 151 ha are irrigated (Source: Climate-data.org).

## MATERIAL AND METHODS

The vegetal material was cultivated on the experimental field in the locality Morata de Tajuña (40 13 46 N, 3 26 11 V) Madrid, Spain. Inflorescence harvesting was carried out at the moment of blooming when the volatile oil accumulation reaches its peak.

Species identification was confirmed by the BUASVM Timișoara, Department of Aromatic Plants, and a voucher sample was preserved at the department. The oils were obtained during hydro-distillation with the help of an Alembic type installation of100 litres. The essential oil was collected and kept in dark glass recipients at a 12° C temperature until usage.

Characterization of the type of soil on which the experiments are carried out.

The studied aromatic plants are not particular regarding the soil. We shall relay in short, the soil particularities required by each crop.

Lavender is not too demanding. It may grow on bare and dry soils, characteristic for sunny hill and mountain slopes. The best results are obtained when lavender is cultivated on deep soils, rich in calcar, permeable and with underground water at a depth of over 2.5 m. Very sandy soils, heavy, argillaceous cold and humid are not indicated for the lavender crop.

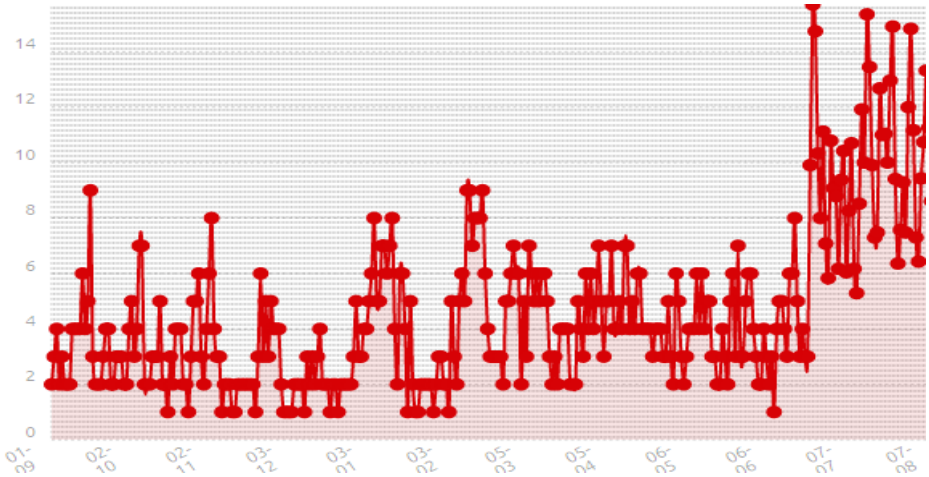
In the case of sweet marjoram, thyme and sage, we recommend light soils, warm, rich in humus. The research carried out by WEICHAN (1950) show that the soil reaction influences the volatile oil content as well as its composition. Alkali soil hinders seed germination and plant development (CORNELISSEN, 1947; SCHRÖDER 1959). The species does not favour cold, heavy soils; also, one should avoid weedy land.

## RESULTS AND DISCUSSIONS

Text TNR 10, normal In 2016 4 drip irrigations were carried put, in February, March, April and May, thus reaching a hydric regime like that of the Banat area, i.e. 600 mm per year. An approx. 50l/m water was used during each irrigation, thus the total hydric supply ranging from 420 l/m2 to 600 l/m2.

### Climatic conditions characteristic of the area

Wind blows mostly from the north-west, from March till October, then it changes direction more from the north, with an average speed of 10 km/hour. It blows the least in December, and most frequent in July (Figure 1).




Source: Climate-data.org

Figure 1. Graphic presentation of the wind speed during 1st of September 2015-1st of September 2016

The climate is steppe, medium-Mediterranean. The annual temperature average is of 14.4 °C, and the precipitations are of 420 mm (Fig. 2).

Temperature regime.

The agro-climatic zonation of the Spanish territory frames the Madrid area within a Mediterranean continental climate with the following characteristics. July is the month with the lowest precipitations, of 9 mm, while November features most rainfalls, 54 mm.

The Morata de Tajuna climatogram (°C)

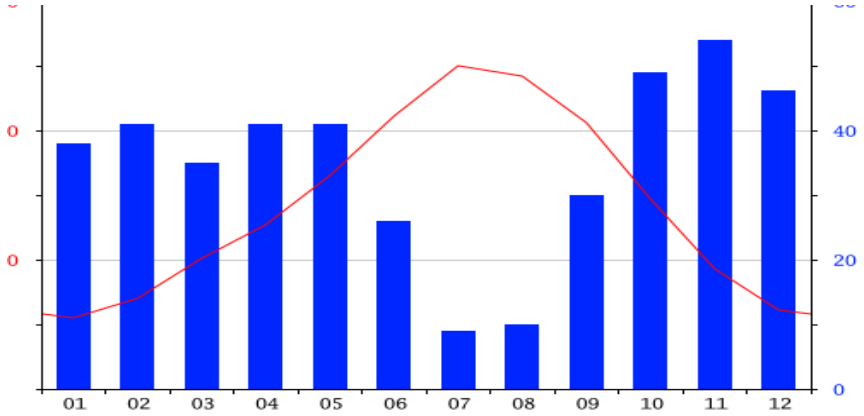



Figure 2. Temperatures during 1st September 2015 - 1st September 2016 ( °C)

Temperature minimums are registered in January, of 1.6 °C, and maximums in July, of 25 °C.

The annual average temperature is of 14.4 °C. Winters are moderate with average temperatures of 6 °C, in January, with frequent frosting and only occasional snow, 2-5 days per year (Table 1).

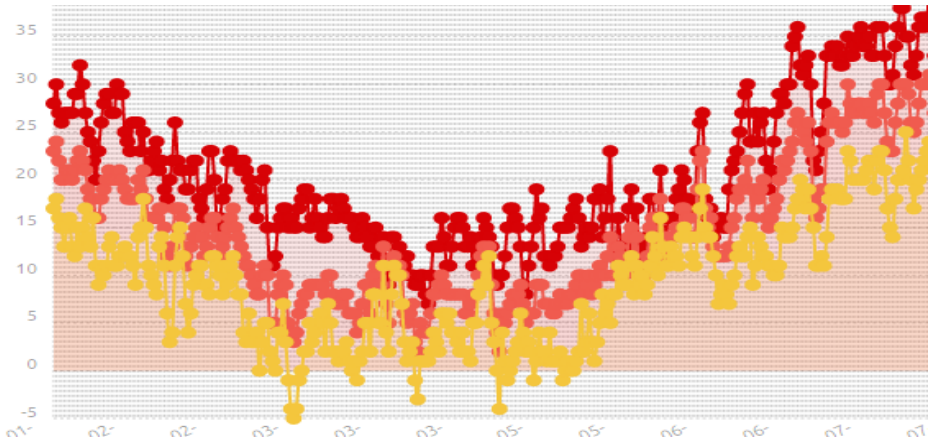
*Table 1.*

Climatic Data: Morata de Tajuna

| month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 38 | 41 | 35 | 41 | 41 | 26 | 9 | 10 | 30 | 49 | 54 | 46 |
| °C | 5.5 | 7.0 | 10.1 | 12.7 | 16.5 | 21.1 | 25.0 | 24.2 | 20.6 | 14.7 | 9.3 | 6.1 |
| °C (min) | 1.6 | 2.2 | 4.8 | 7.3 | 10.4 | 14.5 | 17.8 | 17.3 | 14.4 | 9.7 | 5.1 | 2.2 |
| °C (max) | 9.4 | 11.8 | 15.4 | 18.1 | 22.6 | 27.7 | 32.2 | 31.1 | 26.8 | 19.8 | 13.6 | 10.0 |
| °F | 41.9 | 44.6 | 50.2 | 54.9 | 61.7 | 70.0 | 77.0 | 75.6 | 69.1 | 58.5 | 48.7 | 43.0 |
| °F (min) | 34.9 | 36.0 | 40.6 | 45.1 | 50.7 | 58.1 | 64.0 | 63.1 | 57.9 | 49.5 | 41.2 | 36.0 |
| °F (max) | 48.9 | 53.2 | 59.7 | 64.6 | 72.7 | 81.9 | 90.0 | 88.0 | 80.2 | 67.6 | 56.5 | 50.0 |

Source: *Agency* Estatal de *Meteorology*

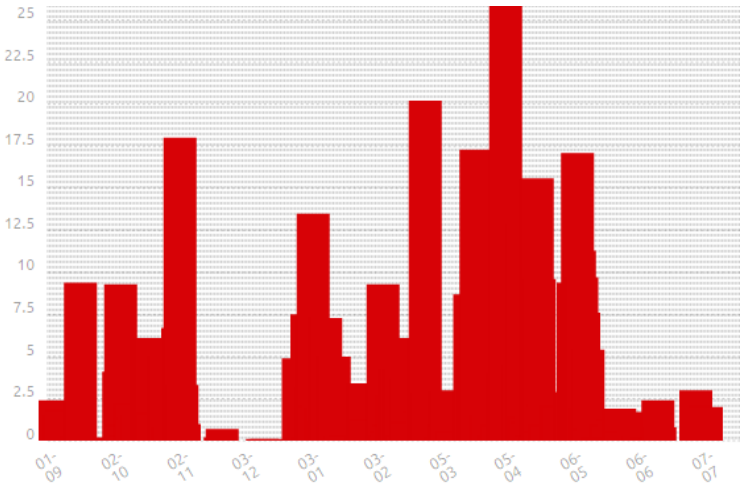
January minimums are situated at a 1.6 °C average, and maximums at about 9. °C (Figure 3). The warmest month is July with a 25 °C average, with a maximum temperature average of 33 °C, and a minimum average of 18 °C. A significant characteristic is the daily temperature amplitude, which may easily exceed 13-10 °C – the difference between day and night, due to the winds.




Source: Agency Estatal de Meteorology

Figure 3. Temperature during 1st September 2015 - 1st September 2016 °C

Atmospheric precipitations, presented in *figure 4*, are not uniform during the course of the year. The lowest precipitation quantities fall in July, 9 mm, And August, 11 mm, November registering 54 mm. this monthly distribution is fairly ideal for aromatic plants. During the month of intense vegetative growth, in the case of sage, and during efflorescence and blooming stages with lavender, one may observe that there is enough water. The second harvest can be obtained only in irrigation conditions.




Source: Agency Estatal de Meteorology

Figure 4. Precipitations (mm) 1st September 2015-1st September 2016

As a first production year, a second harvest is not expected, since the plants need to resist through summer on low precipitations in July and August. By disrupting the hydric supply through irrigation water, we force the plants to develop in-depth roots, and heighten their drought resistance.

The volatile oil quantity obtained from each medicinal plant species under study is presented in table 2.

*Table 2.*

Partial results regarding the herbal production (kg/ha) and the oil content (%)

| Ct. No. | Cultivated species | Herba oil % | Herba kg/ha | Oil l/ha |
|---|---|---|---|---|
| 1. | *Salvia officinalis* L. | 1.27 | 660 | 8.4 |
| 2. | *Salvia officinalis* L. | 0.87 | 824 | 7.2 |
| 3. | *Salvia officinalis* L. | 0.9 | 944 | 8.4 |
| | **X** | **1.013** | **809.33** | **8** |
| 1. | *Lavandula angustifolia* L. | 1.18 | 608 | 7.2 |
| 2. | *Lavandula angustifolia* L. | 1 | 444 | 6 |
| 3. | *Lavandula angustifolia* L. | 1.29 | 836 | 10.8 |
| | **X** | **1.156** | **629.33** | **8** |

## CONCLUSIONS

Average monthly temperatures, the sum of temperature degrees, are favourable for aromatic plant cultivation. These are temperatures practically optimal for plat cultivation, when associated with irrigation.

In conclusion, the climatic conditions described are optimal for the cultivation of medicinal and aromatic plants. Considering the fact, that these are adapted plants, with a genetic conditioned resistance, they are recommendable for this area. If we associate the fact that for other crop plants the temperature and especially humidity conditions are less

favourable, we can state that, in the Madrid area, aromatic plants may be cultivated successfully.

Aromatic plants generally require a warm climate with low precipitations. The critical stage for the water necessity is the vegetative growth, efflorescence and blooming stage. If, in anterior months, the hydric supply is sufficient, during the months the aromatic plants bloom, they do not require a high level of precipitations. Rain falls during the blooming and harvesting stages will affect the volatile oil quality. One ay observes that, the agricultural year of 2016 (Spain) displays a normal climatology, which does not differ significantly from the average. We can thus claim that, for the crops of the experimental field, the pedoclimatic conditions were favourable.

The average herbal production (*Salvia Herba)* obtained was of 809.33 kg/ha. The volatile oil content in dry herbal ranges up to 1.013 %. The essential oil quantity obtained from dry herbal in 2016 from *Salvia officinalis* L was of 8 l/ha.

From the experimental field under study, the average quantity of essential oil obtained from fresh inflorescences in 2016 from *Lavandulae augustifoliae flos* was of 8 l/ha, and the average production of fresh inflorescences was of 629.33 kg/ha.

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