RESEARCHES REGARDING THE PHYSIOLOGY OF LAVENDER PLANTS GROWN ON SOILS WITH DIFFERENT PH VALUES

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ABSTRACT

The researches presented in this document are focused on physiological and biochemical mechanisms that lead to an increased tolerance towards soil's pH values. Such researches can provide important information on plant response and adaptation to changes in environmental factors.

The two studied species of lavender, Lavandula angustifolia and Lavandula stoechas can grow on soils with a pH between 5,5 and 8.5, but seed germination, photosynthesis, optimum water content tissues, are recorded at neutral pH.

On calcareous soils with increased pH, nutritional occur deficiencies which result in reduced photosynthesis, assimilatory pigments content, and therefore, the growth process.

INTRODUCTION

Lavender is a hardy, herbaceous, bushy plant or shrub with straight, woody branches reaching 40-80 cm in height.

The leaves are opposite, 30-50 mm long, 2-5 mm wide, lanceolate and light greyish-green with a downy appearance. The flowers with tubular and bilabiate corolla are grouped in a inflorescence(Niculescu Mariana, 2009).

It has medicinal properties, are grown as an ornamental plant, and her flowers are meliferous (http://ecoport.org/ep?Plant).

Researches conducted so far on this plant aimed the effect of fertilization on growth habit and colour of flowers(Papafotiou,M.,2000), and the water deficit in combination with high solar radiation(Munee-Bosch S.,2001).

Constantinescu Emilia et al(2004), recommend the species *Lavandula angustifolia* for the biocenosis of the sands in southern Oltenia, Romania.

There is not enough data in the specialized literature concerning the behavior of *Lavandula stoechas* on the soil with different pH values, but multiple studies done on other species of plants grown on calcareous soils have lent to the elucidation of the aspects about mineral nutrition of those.

The presence of carbonates in calcareous soils controls several aspects of nutrient availability(Bui et al,1990). Chemical properties influencing nutrient availability on calcareous soils are high pH values and a high concentration of bicarbonate and Ca^{2+} ions in the soil solution.

Nutritional and physiological problems in trees growing on calcareous soils may be related either to high concentrations of carbonate or bicarbonate ions, or to deficient or excess nutrient elements. High carbonate ion (CO_3^{2-}) concentrations may have an adverse effect on seedling emergence and growth, as well as on mycorhizal development (Lapeyrie and Bruchet, 1986).

Decreased availability of soil Mn, Zn, Cu and B are also associated with calcareous soils. Decreased availability of these elements results from both pH effects and interactions with soil carbonates. Similary to Fe, inorganic Mn and Zn are less soluble in the alkaline range of pH, and are precipitated as carbonate minerals (Marschner, 1995).

MATERIAL AND METHODS

In experiments we used two species of lavender, *Lavandula stoechas Anouk* and *Lavandula angustifolia ,,Hidcote Blue,,.*

Lavandula stoechas (french lavender) is an old variety, cultivated for more than 400 years, and a favourite both for its intense fragrance and for the short dense flower spikes topped with a flourish of conspicuous rich violet bracts.

Lavender prefers the ground temperature to be around 13 to 18°C.The seeds germinated in 21 to 90 days.

Lavenders do best in moderately fertile, well-drained, alkaline soils in full sun. Once established they thrive on poor, dry, stony soils, but do not tolerate water logging (www.rhs.org.uk/Plants).

Lavandula angustifolia 'Hidcote' is a bushy dwarf evergreen shrub with narrow, silvery-grey leaves and small deep violet-purple flowers in dense, aromatic spikes 3-4cm in length (www.rhs.org.uk/plants).

Lavender is a typical xerophyte. It can exploit dry soils, but it cannot grow in too humid places or at locations where the ground water is high. In these areas the ability to withstand frosts is also reduced, and the accumulation and quality of essential oil is not sufficient either. (www.seedaholic.com).

Seeds from both species of lavender were sown in April 2015 in vegetation pots, using three different variants:

- mesotrophic peat + pearl stone - pH 5,5;
- eutrophic peat + pearl stone – pH 7;
- eutrophic peat + pearl stone + calcium carbonate -pH 8,5.

In order to determine the value of soil pH, 20g of soil dried in the presence of air was introduced in a 50 ml Erlenmeyer glass and there were added 20 ml of distilled water. The content was stirred for 30 min. and after the decantation, the value of the pH was measured using a pH/meter.

Until the rising moment, the soil was watered every two days and after the rising, every four days.

During these experiments, the germination energy of seeds, diurnal variation of photosynthesis, transpiration intensity and the content of assimilating pigments……..

The diurnal variation of photosynthesis was determined using the portable analyzer Lci, simultaneously being measured the temperature in the assimilation room.

The diurnal variation of transpiration intensity was determined using the Lci analyzer and the amount of chlorophyll with the portable chlorophyllmeter Minolta.

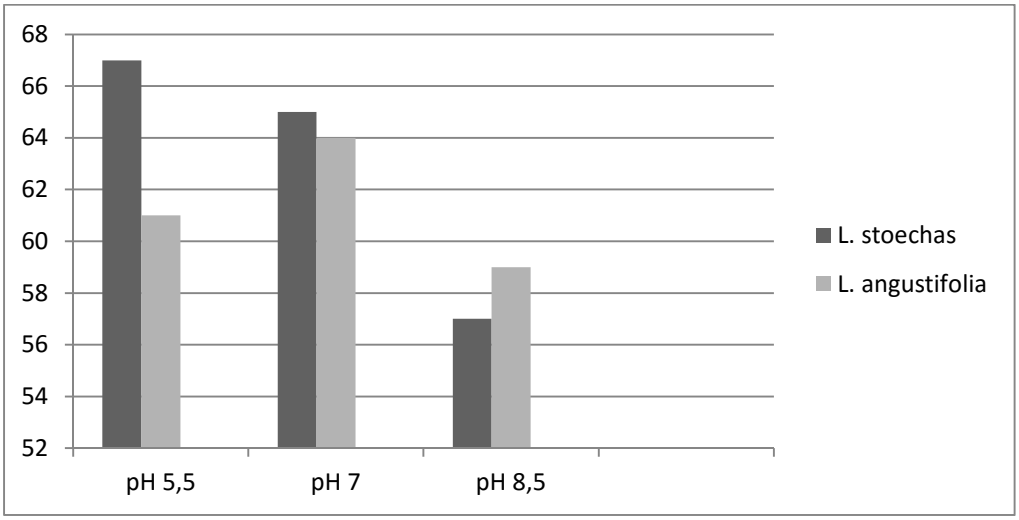
RESULTS AND DISCUSSIONS

The germination energy of seeds was determined at 25 days after the seeding by counting the number of emerged plantlets.

According to data presented in graph 1, the best germination energy was present at seeds from the soil variant with an acid pH at the *Lavandula stochas* species

On the soil with a 8,5 pH value, the percent of germinated seeds was of 57% for *L. stoechas* and 59% for *L. angustifolia*.

The lower percentage of seeds that germinated on the soil with an alcaline pH value can be explained as an efect of the reduction in water permeability on the surface of both seeds tegument.



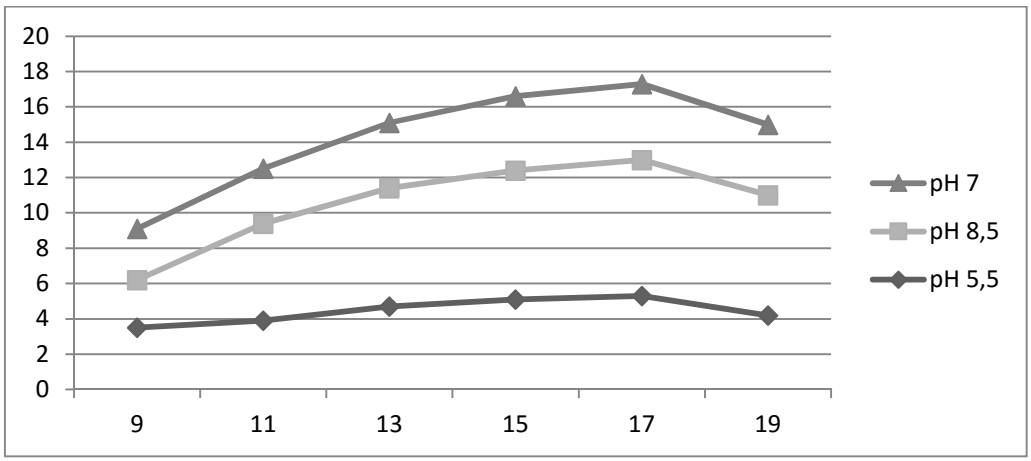
Gr. 1.1.The influence of soil pH of the germinatin energy (%) of *Lavandula sp*. seeds

The diurnal variation in the intensity of photosynthesis registers a maximum between the hours 13-16, hours that correspond to a higher temperature and a high intensity of light.

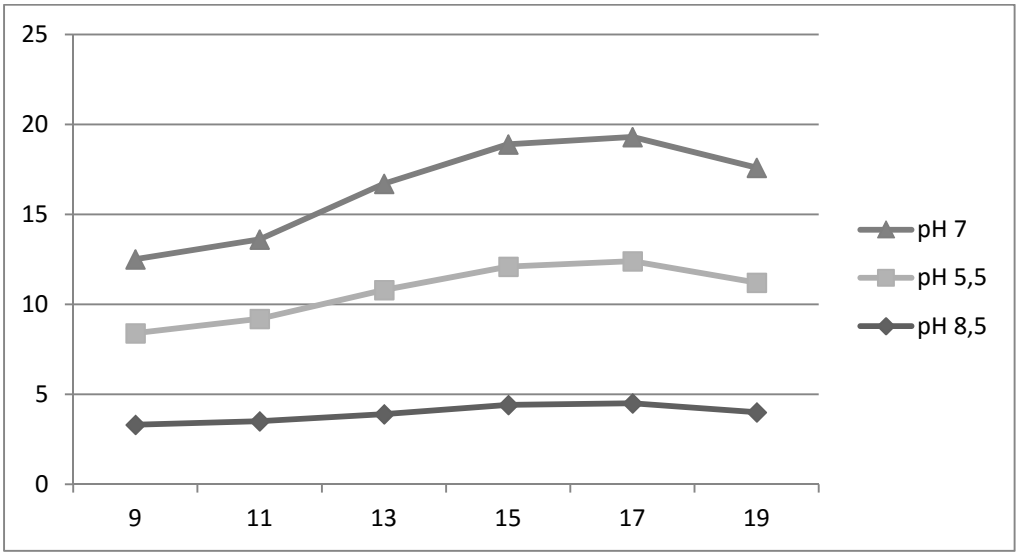
On the soil with an acid pH , the process registers insignificant variations while on the soil with an alkaline ph, the values recorded at different hours of the day present significant differences.

The *L.stoechas* species behave better on acid soil (gr. 2), in comparison with *L. angustifolia*, which presents minimal values of the intensity of photosynthesis in these conditions (gr. 3).

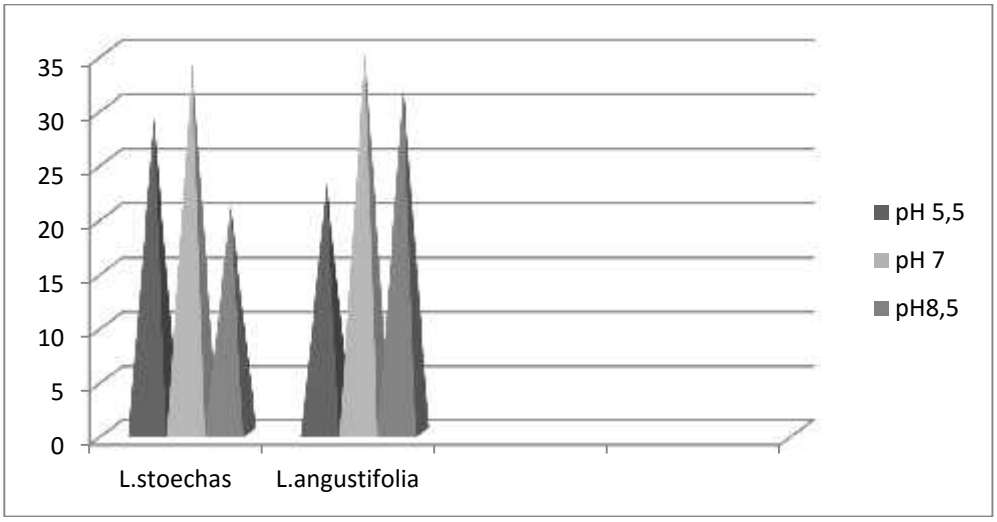
At *L. angustifolia*, the chlorophyll content of leaves registers maximal values at plants grown on soils with neutral pH and minimal values at plants grown on acid soils and *L. stoechas* presents the minimal content of chlorophyll on soils with a 8,5 pH value, having a better behavior on acid soils (gr.4).



Gr. 2. The diurnal dynamic of photosynthesis to the leaves of *Lavandula angustifolia (μmolCO_2/m^2/s)*



Gr. 3. The diurnal dynamic of photosynthesis to the leaves of *Lavandula stoechas(µmol $CO_2/m^2/s$)*



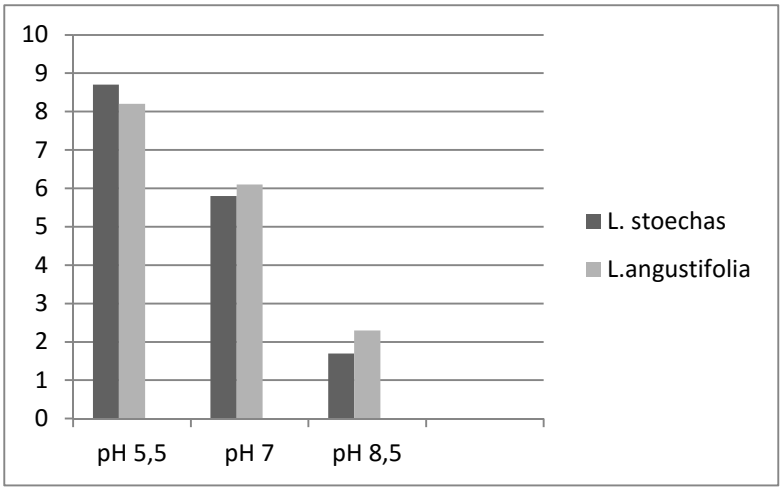
Gr.4 The content of chlorophyll pigments of leaves (SPAD unities)

The reducing of the chlorophyll content on an alkaline soil may be due to the insufficiency of Fe element. The data are in concordance with other data present in the specialist literature according to which iron is the most commonly deficient nutrient on calcareous soils. The manifestation of Fe deficiency on calcareous soils has been recognized as Fe-chlorosis, lime-induced chlorosis, or lime chlorosis. All plants growing on calcareous soils are susceptible to Fe-chlorosis, but vary in their tolerance to it (Loepert et al, 1994).

There are several environmental and soil chemical conditions contributing to Fe-chlorosis (Chaney, 1984), but a definitive soil-based cause has not been established (Chen and Barak, 1982).

Low Fe availability on calcareous soils results from low concentrations of dissolved inorganic Fe at the pH range of calcareous soils (Lindsay and Schwab, 1982), and the reaction of Fe with $CaCO_3$ forming insoluble Fe-oxides (Loepert et al, 1984).

The intensity of leaves transpiration at the lavender presents in general reduced values because of the presence of protective hairs which prevent the elimination of water vapors trough the stomata. At the two species taken into study, on the acid soil has been found a slight intensification of the process while on the alkaline soil, the values are minimal (gr.5). The very reduced values of the transpiration on the soil with a 8,5 pH value may be the result of the reduced process of absorption of water, owed to the decreased permeability for water in the case of the plasma membranes.



Gr.5. The intensity of leaves transpiration (mmol $H_2O/m^2/s$)

CONCLUSIONS

- *Lavandula stoechas* and *Lavandula angustifolia* present a great tolerance towards de pH value of the soil, being able to grow on slightly acid, neutral or basic soils, but the optimal growing take place on soils with a neutral pH;
- The germination energy of seeds records minimal values on the alkaline soil, most affected being in this case the seeds from *L. stoehas*;
- The photosynthesis of the leaves presents minimal values at *L. stoechas* on the soil with an alkaline pH and at *L. angustifolia*, on the acid soil;
- The content of chlorophyll in the leaves decreases on the alkaline pH environment because of the nutritional imbalances that have appeared;
- The intensity of the transpiration records maximal values on the acid soil and minimal values on the alkaline soil at both species.

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