ABSTRACT

About half of the pharmaceutical products from the chemical and pharmaceutical industries used nowadays all over the world are based on medicinal herbs. Furthermore, medicinal herbs are used not only for the preparation of medicinal tea, but also in various domains like food, cosmetics, perfumery and abluents industries. It is estimated that there are about 20000 species of medicinal and aromatic herbs used in both common and scientific therapy, on a global scale, from which 228 herbs are mostly used.

In our country, after the year 1990 not only the surface of the cultivated area, but also the production of medicinal herbs has decreased significantly. The cultivated area of medicinal herbs was of about 27400 ha. in 1990, in 2003 it decreased to 9529 ha. and, it is certainly smaller nowadays. Also, the production has decreased from 20500 tons in 1990 to 5388 tons in 2003.

Medicinal herbs have a major therapeutical importance in various industries like food, cosmetics and perfumery, and there should be larger areas cultivated with medicinal and aromatic herbs.

The present work submits to the idea of enlarging the process of cultivating five species of medicinal and aromatic herbs, i.e. *Ocimum basilicum L., Satureja hortensis L., Salvia sclarea L., Salvia officinalis L.* and *Hyssopus officinalis L.* from the *Lamiaceae* family, taking into account the pedoclimatic conditions in the Tecuci area, conditions which characterize, in fact, the whole south-eastern part of Moldavia.

The five surveyed species register a very good production rate in the given climatic conditions, and, moreover, some of them even surpass the specialty literature; furthermore, the volatile oils obtained from these five cultivated species are rich in odoriferous constituents and mineral elements. The present project is based on the processes of determining the composites from the volatile oil of these herbs, and also the percentage of total mineral substances and mineral elements, always taking into consideration the pedoclimatic conditions of the cultivation area of Tecuci.

The present thesis comprises of 300 pages, with 138 tables and 145 figures.

The first part consists of a summary of bibliographical data about the current national and international knowledge about medicinal and aromatic herbs in the domain of the chosen subject. Next comes the information about the material and the methods used during the research and the information about the natural conditions in which the experimenting of the five medicinal and aromatic herbs took place. The first part unfolds over 100 pages, with 20 tables and 31 figures.

In the second part of the paper there are presented the results of the actual research regarding the title of this present paper. This part comprises 200 pages, with 118 tables and 114 figures.

The experimentation field was set inside the didactic farm of The National College for Economy and Agriculture, Tecuci; the college takes pride in its 85 years of existence, of which 59 years regarding agricultural teaching and study. The unit is settled on the outskirts of the city of Tecuci, on the road towards the city of Galati, and it is the only school for the agriculture in the county of Galati.

The research is based on two methods of arranging the plants on the field: the first method, that of the rectangular Latin layout, for the field experiments on which the influence of chemical and organic fertilization over the herb production was surveyed, following the 9x3x3 scheme, with 9 varieties, 3 repetitions, and 3 columns each with 3 sub-columns; for the field experiments on which botanical, physiological and chemical research was surveyed, based on the pedoclimatic conditions of the Tecuci cultivation area, the square Latin layout was used, following the 3x1x1 scheme, with 3 varieties, 3 repetitions and 3 columns of one row only.

The climate conditions during the experimenting years were favorable for the cultivation of medicinal and aromatic herbs except for the year 2007, when higher temperatures and fewer precipitations were registered throughout the first part of the year. An analysis of the climatic data was made and it was concluded the fact that the average yearly temperature over the last 10 years is bigger with about 1 °C than the average yearly temperature over the last 106 years. The average quantity of precipitations over the last 10 years is close to the average quantity of precipitations over the last 106 years, but a significant change occurred, in the way that in the last 10 years the major part of precipitations is to be met during the second part of the year; during the last 106 years precipitations occurred mostly throughout the first part of the year. This displacement of precipitations towards the second part of the year is affecting more and more the crops.

Ocimum basilicum L.

Phenological observations and assessments regarding the main physiological features of the basil were made. Phenological observations were made in order to determine the growing and development phases of the basil plant, the duration of these two processes over the vegetation period, as well as the influence of climatic conditions over the onset and development of the same two processes. Pictures were added in order to exemplify phonological observations.

From the observations and assessments made regarding the phonological phases of the basil plant, it was concluded that there are very good climatic conditions in the area for the basil to go successfully through the entire process of vegetation. The requirements regarding the

necessary heat are accomplished; as for humidity, if there is draught, there is a need of significant irrigation during the periods of intense growing and development; the lack of enough water during the first period of vegetation leads to a diminished process of development and growing of the plant.

The following physiological characteristics – the vigor of plants, the uniformity of plants, the resistance of plants to draught, diseases and pests – were appreciated by marks using the EWRC scale, ranging from 1 (very good) to 9 (very bad). Given the pedoclimatic conditions of the Tecuci region, the basil plant has a very good resistance to diseases and pests (1 – 1,2) and an above average resistance to draught (4).

The study of morphological features of the basil plant was done through biometrical observations and determinations, both on the field and in the laboratory, using as witness the plant with no fertilizers (the pure plant). The observation took place during the vegetative growing and absolute flowering periods on the whole 9 varieties, and the emphasis was put on the influence of chemical and organic fertilization over the growing and development of plants, as well as on the efficacy of the fertilization regarding the production of herbs.

The results obtained both during the vegetation and the absolute flowering periods show that the basil reacts favorably to chemical and organic fertilization.

The production of basil herbs based on the climatic conditions of Tecuci region was established by the harvest during the absolute flowering period, in the years 2006 and 2007, and the harvest of the witness plants in 2008. The production of fresh herbs in organs in 2006, 2007 and 2008 shows that there are very good climatic conditions in the area for the cultivation of the basil, surpassing the quantities mentioned in the specialty literature. The biggest production was registered in 2008 (20830kg/ha), and the least production was registered in 2007 (20570kg/ha), when climatic conditions lead to the decrease of the basil herbs production.

In 2008, the efficacy of chemical and organic fertilization over the basil plant was also under observation. The method of variance was used in order to capitalize the results of the research. The best influence over the production of the basil was registered by the fertilization with NPK + NH_4NO_3 (23,8% more of the mass produced than the unfertilised plant – the witness plant), followed by the fertilisation with NPK + 2 treatments of liquid stable garbage (22, 0% more than the witness plant). Since the difference between the two methods of fertilisation is not significant (380kg/ha), the latter one is economically more efficient. The worst results were registered by the fertilisation with Foliar – 3 treatments (only 5, 7% more than the witness plant).

In 2008 biochemical observations and determinations were also made regarding: the content of assimilating toners, the content of volatile oil, the processes of separation and dosing

of the composites from the volatile oil, the process of determining the content of total mineral substances and mineral elements in the basil plant, given the climatic conditions of the area.

The dynamics of accumulation of assimilating toners during the phonological growing phases of the basil plant prove a high content of chlorophyll a, followed by carotenoid toners and chlorophyll b, with the highest rate during the vegetative growing period, which decreases significantly until the absolute flowering period begins.

The biggest quantities of volatile oil (l/ha) were registered in 2008 (22460 l/ha), and the fewest quantities were registered in 2007 (18790 l/ha) – a year with higher temperatures which influenced favorably the percentage of volatile oil in the basil leaves. The main odoriferous constituent in the volatile oil of the basil plant, given the climatic conditions of Tecuci, is linalool – 51% (more than the specialty literature asserts).

The content of mineral substances in the basil plant is 15, 71 g/100 g dried substance, more than in the specialty literature. As for the content of mineral elements in the basil plant, compared to the other 4 surveyed plants, the basil is the richest in K and Co, and the poorest in Al, Fe and Mn. The basil and the hyssop accumulate Pb (the basil – 4, 97 mg/100 g dried substance).

Satureja hortensis L.

The phonological observations regarding the garden savory plant put an emphasis on determining the phonological phases of growing and development of the plants, the duration of this processes during the vegetation period, as well as the influence of climatic conditions over the onset and the development of the same two processes.

From the observations and assessments made regarding the phonological phases of the garden savory plant, it was concluded that there are very good climatic conditions in the area for the basil to go successfully through the entire process of vegetation.

The physiological features of the garden savory plant, i.e. the vigor of plants, the uniformity of plants, the resistance of plants to draught, diseases and pests were appreciated by marks using the EWRC scale, ranging from 1 (very good) to 9 (very bad). Given the pedoclimatic conditions of the Tecuci region, the basil plant has a very good resistance to diseases and pests (1 – 1,2) and a resistance to draught noted with 3 (better than the basil).

The study of morphological features of the garden savory plant was done through biometrical observations and determinations using as witness the plant with no fertilizers (the pure plant). The observation took place during the vegetative growing and absolute flowering periods on the whole 9 varieties, and the emphasis was put on the influence of chemical and organic fertilization over the growing and development of plants, as well as on the efficacy of the

fertilization regarding the production of herbs. The results obtained show that the garden savory plant, just as the basil, reacts favorably to chemical and organic fertilization.

The production of fresh herbs in organs in 2006, 2007 and 2008 shows that there are very good climatic conditions in the area for the cultivation of the garden savory, surpassing the quantities mentioned in the specialty literature. The biggest production was registered in 2008 (17210kg/ha), and the least production was registered in 2007 (16910kg/ha), due to high temperatures and draught in the first period of the year.

The biggest efficiency over the production of garden savory was registered by the fertilization with NPK + NH_4NO_3 (21, 4% more than the witness plant), followed by the fertilization with NPK with liquid garbage – 2 treatments (20, 5% more than the witness plant). The difference of production between the two methods of fertilisation, 160kg/ha, makes the latter method of fertilization more efficient economically. The worst results were obtained, as it happened to the basil plant, by the fertilization with Foliar – 3 treatments (9, 3% more than the witness plant).

In 2008 biochemical observations and determinations were also made regarding: the content of assimilating toners, the content of volatile oil, the processes of separation and dosing of the composites from the volatile oil, the process of determining the content of total mineral substances and mineral elements in the garden savory plant, given the climatic conditions of the area.

The dynamics of accumulation of assimilating toners during the phonological growing phases of the basil plant prove a high content of chlorophyll a, followed by chlorophyll b, and the carotenoid toners with the highest rate during the vegetative growing period, the same as for the basil.

The biggest quantities of volatile oil (l/ha) were registered in 2006 (62, 948 l/ha), and the fewest quantities were registered in 2007 (50, 940 l/ha).

The climatic conditions of the year 2007 lead to an increase of the percentage of volatile oil in the garden savory leaves. The main odoriferous constituent in the volatile oil of the garden savory plant, given the climatic conditions of Tecuci, is terpinen – 45, 5% (more than the specialty literature asserts).

From all the five medicinal and aromatic surveyed plants, and analyzing the content of total mineral substances, the garden savory plant is the second after the common sage. The savory garden registers the highest content of B, Cu and Na, and it is the second richest in Fe and Al after the common sage; as for the content of Mg the garden savory plant is the second after the hyssop.

Salvia sclarea L.

From the observations and assessments made regarding the phonological phases of the basil plant, it was concluded that there are good climatic conditions in the area for the common sage to go successfully through the entire process of vegetation. The requirements regarding the necessary heat are accomplished; as for humidity, if there is a longer period of draught, there is a need of significant irrigation during the period of vegetation.

The study of morphological features of the common sage plant was done through biometrical observations and determinations, both on the field and in the laboratory. The best results were registered in 2008, and the worst results were registered in 2007. The same results were also reached by the analysis of the common sage production during the last three years of experiments. The production of common sage plants, compared to the other surveyed plants, is less that in the specialty literature (8800 kg/ha in 2008).

In 2008 biochemical analyses and determinations were made. Analyzing the evolution of the accumulation of assimilating toners during the phonological growing phases of the common sage plant prove a high content of chlorophyll a, followed by chlorophyll b and carotenoid toners, with the highest rate during the vegetative growing period, and the lowest rate during the absolute flowering period.

The biggest quantity of volatile oil from the common sage plant, during the three years of experiments, was registered in 2006 (8, 0 l/ha), yet a less production rate than given in the specialty literature.

The main odoriferous constituent in the volatile oil of the common sage plant, given the climatic conditions of Tecuci, is linalil-acetat – 28, 4% (less than the specialty literature asserts).

The common sage is the second richest in Ca, after the hyssop, and the second richest in K, after the basil. It is the richest in Ba of all five surveyed plants.

Salvia officinalis L.

From the observations and assessments made regarding the phonological phases of the sage plant, it was concluded that there are very good climatic conditions in the area for the sage to go successfully through the entire process of vegetation.

The study of morphological features of the common sage plant was done through biometrical observations and determinations, both on the field and in the laboratory. Analyzing the research results of the sage, it was concluded that the development of the sage throughout the three years of experiments took place in very good climatic conditions, registering higher values and a higher production rate with every year, a production which registered an amount of 9780 kg/ha in the third year, reaching the maximum production given in the specialty literature.

The evolution of the accumulation of assimilating toners during the phonological growing phases of the sage proves a high content of chlorophyll a, followed by carotenoid toners and chlorophyll b, with the highest rate during the vegetative growing period, and the lowest rate during the absolute flowering period.

The quantity of ethereal oil in sage plants grows with every year, and it reaches 30,160 kg/ha in 2008. The climatic conditions of 2007 do not influence significantly the production of sage, but they have influenced favorably the accumulation of volatile oil in both the leaves and flowers of the sage plant.

The main odoriferous constituent in the volatile oil of the common sage plant, given the climatic conditions of Tecuci, is thujona – 36, 4% (less than the specialty literature asserts).

The sage plant is the richest of all 5 surveyed plants regarding the content of total mineral substances; as for the content of mineral elements the sage plant, compared to the other surveyed plants, is the richest in Fe, Mn and Al.

Hyssopus officinalis L.

From the observations and assessments made regarding the phonological phases of the hyssop plant, it was concluded that there are very good climatic conditions in the Tecuci area for the hyssop, being also the least influenced plant by the climatic conditions of 2007. Thus, the values of biometrical measurements of the main morphological features and the production rate increased with every year, getting closer to the values stated in the specialty literature (14200kg/ha, in the third year of vegetation).

The dynamics of accumulation of assimilating toners during the phonological growing phases of the hyssop plant prove a high content of chlorophyll a, followed by chlorophyll b, and the carotenoid toners with the highest rate during the vegetative growing period, and the lowest rate during the absolute flowering period.

The quantity of ethereal oil in sage plants grows with every year, and it reaches 37, 824 kg/ha in 2008, production which confirms the quantities asserted in the specialty literature. The main odoriferous constituents in the volatile oil of the hyssop plant, given the climatic conditions of Tecuci, is pinocamfen – 29, 6% (less than the specialty literature asserts), followed by pinocamfona – 25, 3% (close to what the specialty literature asserts).

From all the five surveyed plants, the hyssop is the richest in Ca, Mg and Zn. The hyssop and the basil, are the only plants that accumulate Pb, the hyssop in a smaller quantity (2, 86 mg/100g dried substance).

In conclusion, the production of herbs regarding the basil and the garden savory surpass the numbers given in the specialty literature; the common sage registered a smaller production of flowers (of about one ton) than in the specialty literature. The production of herbs regarding the

sage and the hyssop is within the limits provided by the specialty literature, a result which recommends the cultivation of the five surveyed plants in the region.

The production of volatile oil, taking into account the pedoclimatic conditions of Tecuci, regarding the basil, the sage and the hyssop is within the limits provided by the specialty literature, whereas the production of herbs regarding the garden savory and the common sage are under the quantities declared in the specialty literature.

The composites from the volatile oil of these five surveyed plants make them very good for their utilization in industries like natural therapy, food, cosmetics and perfumery.

Furthermore, the contents of total mineral substances and mineral elements in the all five surveyed plants recommend them for their use in various domains and also for their benefits for the human body.

The most economically efficient capitalization of these medicinal and aromatic plants, taking into account the climatic conditions of the Tecuci area, is their use firstly for the preparation of medicinal tea, and secondly for the volatile oils they provide. The profit gained from the cultivation of these medicinal and aromatic herbs either for medicinal tea or for volatile oils is significantly higher than the profit gained from the cultivation of grain in the same area.