UNIVERSITY OF AGRICULTURAL SCIENCES AND VETERINARY MEDICINE „ION IONESCU DE LA BRAD" IAŞI

FACULTY OF HORTICULTURE

DOCTORATE FIELD: HORTICULTURE

SPECIALIZATION: VEGETABLE GROWING

Eng. CONSTANDA GABRIELA

married TINCĂ

DOCTORAL THESIS

Scientific leader,

Prof. NECULAI MUNTEANU, Ph D.

IAŞI

2011

UNIVERSITY OF AGRICULTURAL SCIENCES AND VETERINARY MEDICINE „ION IONESCU DE LA BRAD" IAŞI

FACULTY OF HORTICULTURE

DOCTORATE FIELD: HORTICULTURE

SPECIALIZATION: VEGETABLE GROWING

Eng. CONSTANDA GABRIELA

married TINCĂ

DOCTORAL THESIS

„RESEARCH ON THE DEVELOPMENT OF ECOLOGICAL TECHNOLOGY FOR CULTIVATION OF SOME SPICY AND AROMATIC VEGETABLE SPECIES IN THE ENVIRONMENTAL CONDITIONS OF IASSY COUNTY"

Scientific leader,

Prof. NECULAI MUNTEANU, Ph D.

IAŞI

2011

ABSTRACT

Although the knowledge and the use of spicy and aromatic vegetable species began at the same time with the cultivating of plants, being thus known from ancient times, their importance has remained at a low level and, for good reason, undeserved.

The spectacular evolution of scientific knowledge generated the technical revolution, and the therapeutic remedies before the twentieth century have been placed in a shadow corner, the use of spicy and aromatic plants and herbs, has lost thus from its popularity.

Turning to nature for healthy food and herbal remedies, which became more and more justified and more and more present, causes a reassessment of this „green treasure".

Currently, when there is a tendency to reduce the transport distance of food, it has come to an increasing interest to provide food from local resources. We can also notice a return to the concern for old and forgotten varieties of spicy and aromatic plants, which, used in the kitchen, offer a wide range of flavours to satisfy the most pretentious tastes, without which there can't be any modern kitchen today.

At the same time, in the national tradition, the assortment of spicy and aromatic vegetables is a relatively small segment, exemplified by the dill, parsley, thyme, lovage, horseradish and a few others. The chosen topic is interesting, if we consider that spicy and aromatic plants, such as lemon balm, hyssop and borage, have been less studied and popularized.

The ecological agriculture appeared in Europe, as a result of some health problems and negative experiences, caused by the use of synthetic chemicals, generated by the intensive type technologies, based on forcing the production through over fertilization of the agricultural land, natural ecosystems degradation, resource depletion, environment and crops pollution.

It goes without saying that it is desirable that vegetable plants for leaves, which generally have medicinal properties, shouldn't contain substances which are harmful to health. This justifies the interest in cultivating the studied plants under the circumstances of ecological agriculture.

The theme of the thesis is also interesting because, up to the present, in our country, there are little data concerning the crop of the spicy and aromatic plants species in the ecological system.

Knowing the above, I proposed making this thesis, with the mentioned theme, whose goal is to make studies and researches, by which the possibility of cultivating the vegetable species lemon balm (*Melissa officinalis* L.), hyssop (*Hyssopus officinalis* L.) and borage (*Borago officinalis* L.), could be evaluated under the conditions of ecological agriculture in the county of Iasi, with sustainable results.

In order to realize this goal, three major objectives have been established:

-the study of the administrative – organizational and natural framework conditions, in which the researches will be conducted;

-the study of the general suitability of cultivating the species lemon balm, borage and hyssop, in the system of the ecological agriculture at S.C. BIAROM Iasi;

-improving the cultivating technology of the three species, growing in the ecological agriculture conditions in the area of Iasi, through three technological factors: the type of biological material, crop density and fertilization regime.

The researches were conducted during the period 2007-2009, in Iaşi County, BIAROM Farm, using a suitable methodology to agronomical researches in general, and to spicy and aromatic plants, in particular.

The thesis is divided into two parts and six chapters.

- Part I – The technical - scientific knowledge stage.

This part includes the chapters:

Chapter I – General presentation of the ecological cultivation technologies of spicy and aromatic plants;

Chapter II – The importance and agrobiology of spicy and aromatic vegetables balm (*Melissa officinalis* L.), hyssop (*Hyssopus officinalis* L.) and borage (*Borago officinalis* L.).

- Part II – The results of my own studies and researches.

This part includes the chapters:

Chapter III - Goal, objectives and general work methodology;

Chapter IV - The study of the administrative - organizational and natural framework conditions, in which the researches will be conducted;

Chapter V – The evaluation of the cultivation suitability of the species *Melissa officinalis* L., *Hyssopus officinalis* L. and *Borago officinalis* L. in the system of ecological agriculture at the vegetable farm S.C. BIAROM S.R.L Iasi;

Chapter VI – The influence of some technological factors on production, in the system of ecological agriculture from S.C. BIAROM S.R.L Iasi;

Chapter VII – General Conclusions.

The bibliography includes a number of 115 titles of published works in the country and abroad.

The first chapter covers generalities concerning the ecological cultivation technologies of the vegetables. The ecological agriculture appeared as an alternative to intensive agriculture, of the industrial type, being a realization of the nature-loving farmers, based on economically efficient methods and means of production, with nature-friendly and clean technologies. The ecological agriculture places great emphasis on the hygienic, ecological and biological products quality. By the total elimination of the chemical products in the farm life, the ecological agriculture can efficiently contribute to the maintenance of a clean environment, favoring the development of vegetation and animal world.

Some technological links, which are specific to the ecological agriculture, will be presented below.

Organizing an ecological farm must optimally meet the requirements of the cultivated plants concerning the environmental factors and at the same time, respecting some obligatory norms, which are

in accordance with the national and European legislation. These norms relate to general requirements for the organization of an ecological farm in the conversion period, the labeling of ecological products, etc.

When choosing the land for establishing an ecological farm, some things will be taken into account: the protection against major polluting industrial companies; geographical, orographic, hydrographic, climatic location; the socio-economical conditions; traditions; location towards ways of access; distance from market capitalization; the labor existence; soil humus content, etc.

The multi-annual crop rotation is one of the most important and cheapest agrophyto technical measures to increase production. This is beneficial both for the soil and for avoiding the diseases, pests or weeds contamination.

The main difference between the two agricultural alternatives (ecological and conventional) lies in the conception about soil fertilization, which must be maintained and improved through measures that should favor maximum biological activity. The base of fertilization in the ecological agriculture, however, is the natural organic matter produced in farming, and natural mineral fertilizers as a supplement, not as a replacement of the mineral elements recycling.

The control of weeds, pests and diseases in the ecological system is done through a series of measures that integrate both preventive and curative measures.

In order to prevent the spread of weeds, there are things to be taken into account: plant quarantine, rotation and crop rotation, sowing in the optimal time, using a certified and conditioned biological material, plants density insurance, the destruction of the weeds focus on the uncultivated lands, cleaning the agricultural machines before changing the parcel, forcing the weeds and seeds germination. As curative measures the most commonly used are: the hoeing, the weeding, the mowing, the thermic control, the soil mulching, the exhaustion and the provocation method.

For diseases control, as preventive measures, there are the plant quarantine, the conditioning of seeds and planting material, forecasting and warning, host weeds destruction from spontaneous flora. As curative measures, there are the burning the vegetal weeds, infested with diseases, solarization for disinfecting the contaminated seeds and fruits, obtaining, through genetic improvement, some plant species which are tolerant or resistant to pathogens attack. As chemicals products for diseases control, the copper, sulfur and silicon - based products are allowed.

For pests control, as curative measures, mechanical control is recommended, by collecting and destroying harmful insects, by using ditches and belt traps etc.

The admitted products for manufacturing the traps are: the pheromones, the natural Pyrethroids, the metaldehyde and the phosphate diammonium.

Among chemical pest control methods, the alum or potassium soap, flour basalt, vegetable oils, paraffin oil or mineral oils are allowed.

The control with the help of insects, of viral bioproducts, of bacteria based preparations, and herbal products, etc., can also be used.

Chapter II presents the importance and agrobiology of the studied spicy and aromatic vegetables. They have food, medicinal, honey, ornamental importance and they are also widely used in the perfume, soaps, cosmetics industry, etc.

From the lemon balm, borage and hyssop, stems and leaves are used, fresh or dried as spicy for a variety of dishes (salads, soups, dips, marinades, pickles, mushroom dishes, meat and fish), which enhances the flavor and digestibility; pastry doughs and products, or manufacturing of liqueurs and refreshing drinks, the candies drops or compotes – as flavoring.

As a medicinal importance, both the lemon balm and the hyssop are beneficial in liver, digestive, respiratory, nervous system diseases, etc.

From the borage plants, preparations with emollient, expectorant, anti-inflammatory, hormoneregulator and euphoric effect can be obtained. The seeds of this plant are considered now as the main source of the vegetable world, for the extraction of the essential fatty acids.

The agrobiological particularities put into evidence some features. The lemon balm and the hyssop are perennial plants of the Labiatae family from the Mediterranean area. Borage is an annual herbaceous plant.

The ecological particularities reveal us the ecological rusticity and plasticity of these species, which found optimal conditions in the plain and hill areas of our country. The lemon balm and the hyssop, however, are sensitive to low temperatures (below -25º C) during the winter, unless they are covered with a layer of snow.

Chapter III presents the goal, major objectives and work methodology for achieving those objectives, which have already been referred to.

The used biological material consisted of seeds and seedlings from the three studied species studied and as well as the crop from each culture.

In order to achieve the first objective, observation, documentation, comparative analysis, statistical grouping and data systemazing have been used as work methods.

For solving the second objective, the basic method was the experiment. In this respect, between 2007 – 2009, in an experimental field, divided into three parcels, one for each crop, there were three organized collections with different origins of lemon balm, hyssop, and borage respectively. At the level of these crops, observations and measurements were carried out.

To achieve the last objective the specific method was the experiment. It consisted of the organization of a series of three experiments, of the polifactorial type, organized in a subdivided parcels device. During these experiences, three experimental factors have been studied (the type of biological material used in the creation of the crop, the crop density and the fertilization regime), as well as the combinations of the three factors, following the influence of the experimental variants thus generated, upon the production in the conditions of ecological system.

Chapter IV has as a general goal the study of administrative - organizational and natural framework conditions in which the researches have been conducted.

In order to achieve this major objective, two specific objectives were developed: the study of the administrative and organizational conditions, with reference to the profile of the unit where the researches were performed, and to the structure of the crops from the vegetable farm, and the study of the natural framework conditions, with regard to relief, pedology and hydrology; climatic and meteorology conditions, flora and fauna, risk factors for the ecological crop.

Studies have been realized, based on factual material, respectively data on the values of the main physical and economical indicators, which define the analyzed factors.

As a work method, the analysis, the comparative study, the case study, the observation, etc., have been used.

Regarding the study of the administrative - organizational conditions, the general conclusion that can be drawn is that, in the BIAROM farm, optimal technical – organizational conditions were met for conducting the researches.

As far as the study of the natural framework conditions is concerned, with regard to relief, pedology and hydrology, climate conditions and meteorology, flora and fauna and risk factors for the ecological crop, it can be concluded that the studied spicy and aromatic plants had, from all points of view, optimal conditions of development.

Chapter V refers to the second major objective, the evaluation of the cultivating suitability of the species lemon balm, borage and hyssop, in the system of the ecological agriculture from S.C. BIAROM Iasi.

In order to achieve this target, under the actual working conditions at S.C. BIAROM, the following specific objectives were established: the morphological characterization of the three species taken into culture, the physiological characterization of the studied species, the agro productive characterization of the crops of the three species.

The material used consisted of seeds, seedlings, plants and parts (plant fragments) as well as the fresh and dry crop from the three cultivated species.

The work method consisted of making observations and measurements during the three years of study.

Regarding the morphological characterization of the three species taken in culture, it can be concluded that all the species showed the specific morphological characters (plant size, shape and color of leaves and flowers, etc.), which indicates a very good adaptability to the conditions in which the experience has been performed.

The second specific objective, the physiological characterization was achieved through two sub objectives: the phenological characterization of the species taken into culture and the study of chlorophyll pigment content.

The phenological study was based on the observations expressed in number of days from a phenophase to another for the following phenophases: the arising, the first true leaf stage, the first branch stage, the appearance of the first flowers, flowering time, harvesting, resistance to diseases.

The study of the foliar pigments was realized by the spectophotometric method and revealed the quantitative and qualitative presence of these pigments as a fundamental expression of plant adaptation to the bioconversion process and of adaptation to environmental conditions.

The agro productive characterization of the three species underlines some particularities regarding the productive potential, under standard cultivation conditions.

To sum up, in the balm, the fresh vegetative mass production averaged 18.15 t/ha, in the hyssop it averaged 14.93 t/ha, and in the borage 15,30 t/ha.

Chapter VI refers to the third major objective of the thesis, the agro productive characterization of the three specific crops.

To achieve this goal, the researches which were carried out, focused on the following specific objectives: establishing the influence of the biological material type used in the creation of the crop on the fresh and dry mass production in the three studied species, establishing the influence of the crop creation density on production, establishing the influence of the fertilization regime on production.

Regarding the first objective - to establish the influence of the biological material type used in the crop creation, on fresh mass production, in the lemon balm and hyssop perennial species, it can be concluded that crop creation material, starting with the second year, does not significantly influence the production. At the annual species, however, (borage), at the crop created by seedling, there were significantly positive production differences unlike the average experience.

Regarding the second goal - establishing influence of the crop creation density on production, fresh (and implicitly dry), the results presented that in the balm case, with medium density, that of 130 thousand plants/ha, determine the greatest production of 22.32 t/ha, while in the hyssop case, the largest fresh vegetal mass production was obtained for the variant with 180 thousand plants/ha, 18.65 t/ha. In the borage case, the superiority of a high density (180 thousand plants/ha) resulting in a fresh vegetal mass production of 19.14 t/ha is confirmed.

Referring to the last goal - establishing influence of the fertilization regime on production, it is concluded that the best variant was that treated with Cropmax, which generated a production of 22.9 t/ha balm, of 18.57 t/ha hyssop and 18.88 t/ha Borago.

In his thesis the influence of the combinations of the two experimental factors on each species, has also been studied, but the most conclusive experiment was the study of the influence of the combination of the three experimental factors, in which 24 variants have been studied, resulted from a combination of all the three graduations of the experimental factors on each species.

From these results and the significance of their differences it can be said that: in the balm, the highest production (24.01 t/ha) was obtained from a crop created by seedling, at a density of 130 thousand plants/ha and fertilized with Cropmax product (variant V_{18}), in the hyssop, the seedling variant, at a density of 180 thousand plants/ha and fertilized with the Cropmax product, in the borage, the variant created by seedling, with 180 thousand plants/ha, fertilized with Cropmax, showed a fresh vegetal mass production of 21.19 t/ha.

So the goal and the objectives of the thesis were fully met.

The experiences performed show that the ecological techniques applied to spicy and aromatic crops can result in sustainable economical results.

The results obtained from these researches will represent theoretical and practical solutions for specialists regarding the possibility of cultivating these species in the ecological system and enrich the national knowledge fund about the agrobiology of the balm, borage and hyssop species.