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DOCTORAL THESIS ABSTRACT

**RESEARCH ON THE BEHAVIOUR OF TREE VARIETIES IN
SOUTHERN OLTENIA SANDY SOILS IN THE CONTEXT OF
CLIMATE CHANGE**

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ABSTRACT

INTRODUCTION

The fruit tree culture has enjoyed great attention over time, following the course of the general evolution of human society, undoubtedly constituting man's first type of food. Contributing to the improvement of the population's food, fruit tree culture is of particular economic and social importance. Due to the very complex chemical composition, the fruit, as food for the healthy or ill, represent special food. Fruit water is pure, biological water that helps to hydrate the body (BACIU, 2005).

Based on the millenary tradition of tree cultivation and the expansion of the areas occupied by trees, fruit growing has become, over time, a basic branch of agriculture that has a well-defined and recognized infrastructure on the domestic and foreign markets.

An important role in the activity of awakening and developing the interest for the tree culture, the popularization of some special achievements, as well as the stimulation of the producers, has belonged to the fruit exhibitions organized periodically in different localities in the country since the second half of the last century (STĂNICĂ, 2011).

The purpose of the research has been the study of the behaviour of some tree species on sandy soils in the context of climate change, in order to establish their performance and their recommendation for production.

Five goals were outlined in order to achieve the goal, out of which several specific objectives detailing the stages of realization of the experiences in order to achieve the goal. In this respect, it should be noted that the experience was placed in the experimental field of the Dabuleni Sands Research and Development Centre.

The doctoral thesis is structured into two different parts, containing eight chapters, totalling 193 pages. In the elaboration of the thesis 129 bibliographic sources were consulted, including books, scientific papers and specialized sites from both the country and abroad.

The results obtained from the research were concretized in a series of conclusions and recommendations that can be useful not only to the specialists, but also to the general public.

PART I THE CURRENT STATE OF KNOWLEDGE IN THE FIELD

The first part of the doctoral thesis consists of two chapters which incorporate current information on the current state of research, the effects of climate change on tree species.

Chapter I presents the present stage of knowledge in the field regarding the usefulness and importance of the studied tree species - apricot, plum, cherry, sour cherry, in Romania and worldwide.

The second chapter presents the current situation and trends in the development of fruit growing in our country.

The fruit tree plantations in our country are spread in different areas with specific climatic conditions. Tree species are differentiated according to their requirements for climatic factors. Depending on the temperature, about 90% of plantations are located in areas where the average air temperature is between 7°C and 11°C.

The response of plants to major climate changes is accurately reflected by alteration of the phenological patterns known and attested by classical studies. Parameters that mark the phenological stages from the appearance of the buds to the fall of the leaves and the end of the vegetative cycle, associated with the corresponding physiological data, generate authentic data for the study of the climatic changes effect.

The second part of the paper begins with **the third chapter** regarding the peculiarities of the environment in which the experience took place, with general data on the lithology and geology of the sandy soils, the hydrography and hydrogeology of the studied area, the natural and cultivated vegetation as well as the favourability of the sandy soils in southern Oltenia for the growth of the studied species.

Chapter IV begins with the purpose and objectives of the research, the description of the materials, the approached working methods and the place where the experiences were held.

The purpose of the research was to study the behaviour of some tree species on sandy soils in the context of climate change in order to determine their performance and their recommendation for production.

The experiments were placed within the Dăbuleni Sands Research and Development Centre. In the experiments, 14 apricot varieties, 4 cherry varieties, 4 sour

cherry varieties and 4 plum varieties were studied, some of which were part of the varieties recommended for sandy soils many years ago.

In **Chapter V** are presented the results of the climatic conditions analysis and soil characterization in the experimental field. To provide a response to this theme, observations and determinations were made over the period 2014-2017 as follows:

1. Climatological analysis of the area;
2. Soil analysis in the experimental field;
3. The influence of environmental factors on the phenology of vegetative and florid organs in apricot, plum, cherry and sour cherry species in the southern Oltenia area;
5. Winter rest and the resistance of apricot, plum, cherry and sour cherry flowering buds to the local temperatures;
7. The influence of environmental factors on the apricot, plum, cherry and sour cherry regarding the elements of the overall force of trees;
6. The climate change effects in the sandy soils area on certain processes and physiological indices in the fruit species of the experimental field.
8. The influence of environmental factors on apricot, plum, cherry and sour cherry regarding fruit productivity and quality.

Chapter VI begins with results on the initial and final phenophases of vegetative and fruit organs in the fruit species of the experimental field, as well as the influence of the resting period on the viability of vegetative and florifery buds in the studied species.

On the sandy soils of Dăbuleni during the three years of study the climatic conditions during the winter-spring period were very different, with very high air temperature oscillations, from positive temperatures of 15°C to -23°C, due to the presence of rainfall in the form of snow in a 40-50 cm layer or a total lack thereof.

The percentage of viable buds in the apricot varieties studied in the period 2015-2017 ranged between 47.6% for Mamaia variety and 57% for the Olimp witness variety. All studied varieties showed a lower percentage of viable buds compared to the witness variety. Values close to the witness variety were determined in the varieties: 'Auraș'(56,6%), 'Orizont' (56%), 'Cristal' (53,6%), 'Fortuna' (55,6%).

Plum, cherry and sour cherry species were less affected by low winter temperatures, as they are frost-resistant species. These species were more influenced by

March and April rime and by the very high temperatures recorded in the second decade of April, followed by precipitation periods that affected the binding of fruits.

The apricot's vegetation start is marked by swelling of the buds, a phenomenon observed after several days with average temperatures of 5-7°C. In the apricot, the phenophases are very alert, first the flowers appear and then the leaves. The specialized literature indicates a 6-6.5°C biological threshold for entering the vegetation, and in the sandy soil conditions at Dăbuleni, in the period 2015-2017, this threshold has been between 9,6-11,3°C.

The swelling of apricot buds in 2015 took place between March 18-20, in 2016 between March 19-23, and in 2017 between March 20-24, and the opening of the buds in the last decade of March for all the studied varieties. It can be noticed that from year to year the period of bud swelling increased by up to 4 days.

In the plum, cherry and sour cherry species, the swelling of the buds and the beginning of the defoliation begin in the last decade of March, in the sandy soil area of Dăbuleni, and the blooming phenophase begins in the second and third decade of April.

In the evolution of growth and fructification phenophases, the observations made during the three years of study highlighted the fact that, besides the genetic determinant of the variety, climatic conditions had a different influence. Thus, in the three years of experimentation (2015-2017), the climatic conditions in 2015 caused earlier phenophases of growth and fructification by about a week, compared to 2017.

Subchapter 6 shows the results regarding the growth rate of the annual shoots and the elements of the overall force of the trees.

In the case of sandy soil apricot, plum, cherry and sour cherry in the context of climatic changes, the following determinations were made: trunk diameter, tree height, crown diameter per row and crown diameter between rows.

Subchapters 6.2 and 6.3 show the influence of sandy soils temperatures in starting tree vegetation, depending on the biological threshold.

The temperature required for starting the apricot in the vegetation is 5,5-6°C, and in the sandy soil area of Dăbuleni, the air temperature during the entry of the trees into the vegetation reaches this threshold and even exceeds it. In this area, at the time of the main vegetation phenophases in the apricot species, the following values of the active, global and useful heat balance were registered:

The temperature required to start the plum vegetation is 7⁰C. In the area of sandy soils in southern Oltenia (Dăbuleni), during the start of plum vegetation, temperatures between 3,2⁰C in 2015 and 17,4⁰C were achieved in 2016. If the average temperature for the plum species is 8-10 , 5⁰C, on the sandy soils the average temperature exceeds 12⁰C.

If the mean temperature for the sour cherry species is 15-17⁰ C, the average temperature on the sandy soils was between 17.5 and 19.2 ° C. The global heat balance for the sour cherry during the vegetation period is 3,5-4,5⁰C, and on the sandy soils there is a global heat balance between 4,2-4,6⁰C, and this year the global thermal balance is likely to be even higher.

The active thermal balance for triggering the main phenophases of the sour cherry species in the sandy soils area falls within or exceeds the values indicated by the specialty literature. Also, in the cherry, the global and active thermal balance for the main phenophases in the sandy soils area falls within or exceeds the values of the specialty literature.

Chapter VII presents the effects of climate change in the sandy soils area of southern Oltenia on some physiological indices in the fruit trees of the experimental field.

Research on physiology focused on the influence of climatic conditions onto tree metabolism. In apricot, plum, cherry and sour cherry species, the following determinations were made in the intensive growth phase of shoots: leaf water forms (total water, free water, bound water), dry substance and cellulose juice concentration.

Fruit trees (plum, cherry and sour cherry) showed less water compared to the apricot, but the percentage of bound water and dry leaf material increased. Also, the cell juice concentration reaches values of up to 24.85% in these species. These results highlight the greater resistance of these species to stress conditions.

Research has also been carried out on the influence of climatic factors on sandy soils on some physiological processes in the experimental fields.

The determinations made in the apricot species in the three years of study highlight the importance of the cultivated variety as well as the influence of the climate conditions in the field area. The determinations were made during the intensive growth phase of shoots (the last decade of June).

Cherry, sour cherry and plum trees demand less heat than peach and apricot, but are pretentious to the water factor, the best production results being obtained in areas with 700-800 mm annual rainfall.

The paper ends with **chapter VIII**, presenting results on the fruit production and nutritional quality of the fruit species in the experimental field, but also conclusions and recommendations.

Production is an important factor in choosing varieties of a tree species, but not only, to set up a plantation. In apricots, due to climatic conditions in the years 2015 and 2016 the trees did not produce. Only in 2017, determinations were made regarding the production of fruit.

In the apricot, the fruit production ranged from 3.88 t / ha for the 'Amiral' variety and 8.90 t / ha for the 'Dacia' variety. The most productive varieties were: 'Dacia' (8,90 t / ha), 'Mamaia' (8,32 t / ha), 'Orizont' (7,70 t / ha) and 'Auras' 58 t / ha). In the climatic conditions of 2017, the only variety that showed a significant increase in production compared to the witness was the 'Dacia' variety (1.23 t / ha).

For the plums, the following varieties were used in the study 'Carpatin', 'Stanley', 'Minerva' and 'Tuleu Gras'. The climatic conditions in recent years have affected fruit production due to the very low temperatures during the winter, which were recorded after warm periods, the temperature amplitude being from + 15°C to -24°C and the late spring rime which in the year 2016 affected the flowering buds in 100%. 2017 was the only production year, and the studied varieties were differentiated.

The studied varieties 'Țarina', 'Ilva', 'Meteor' and 'Nana' behaved differently in terms of production in the climatic conditions of 2017, the only year with production during the study period 2015-2017.

Fruit quality has shown high variability as to climatic conditions, especially due to the temperatures and precipitations of the growing and maturing period of the fruit. The apricot varieties that showed (very little) fruit in the climatic conditions of 2015 were: 'Olimp', 'Dacia', 'Harcot', 'Goldrich', 'Cristal', 'Ceres', 'Auraş', 'Histria' and 'Fortuna'.

The results obtained with regard to the size of the apricot fruits show the good behaviour of the studied varieties from a productive and qualitative point of view. The largest fruit in the apricot species belonged to the 'Goldrich' variety (98 g in weight, 5.70 cm in diameter and 6 cm in height).

In the sour cherry, the total dry substance ranged between 14.63% for the 'Meteor' variety and 17.84% for the 'Nana' variety. The higher the amount of total dry matter, the lower the amount of water in the fruit.

The sour cherry fruit of the studied varieties showed a dry matter content of 12.3% for the 'Meteor' variety and 14.7% for the 'Nana' variety. Vitamin C content was variable, ranging from 3.52 mg in 'Tarina' and 14.08 mg in 'Nana'.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

Climate change in the sandy soils area has become increasingly obvious and is manifested by:

- Increase of the average annual temperature over the last 9 years by 0,8°C compared to the multi-annual average of 1956-2016 (from 11,36°C multiannual average to 12,2°C annual average in 2008-2016);

- The sum of the temperature ranges in the period 2008-2016 was 4440.8°C and the sum of the multi-year temperature ranges was 4146.4°C, thus 294.4°C more than the multiannual sum.

- The annual rainfall increase over the past 9 years by 30.88 mm compared to the 1956-2016 multiannual amount (from 561.21 mm multiannual amount to 592.09mm annual amount in 2008-2016). 2014 was the year with the highest rainfall, the annual sum of 994 mm being a record for the 59 years since the recordings of climate data at Dăbuleni.

- The increase in the average temperature of the autumn months and the beginning of winter (October to December) by 0.6°C compared to the monthly multiannual average for the three months (6,4°C monthly average over the three months 2008-2016 and 5.8°C multiannual average in the three months);

- The early arrival of spring due to temperature rise, but with rime or precipitation during the flowering period, which can affect the harvest. In 2016, the rime of March 17 totally destroyed the flower buds of all the studied species. Also, the increase in average temperatures in the spring months led to a much earlier phenophase. 2015 had the earliest spring of the three studied years.

- Due to the average temperature increase in the area, late varieties began to mature their fruit almost 12 days earlier, and by shortening the growing season, the fruits no longer grow normally and the accumulation of some biochemical components in the fruit is affected.

- The lack of precipitation in certain phases of vegetation contributes, besides increasing the temperature, to diminishing the vegetative and fruit growths.

As a recommendation, the success of apricot, cherry, plum and sour cherry plantations in this area depends on the application of all the factors of the establishment and maintenance technology, with the provision of the water factor, which is limited for this area. Also by establishing valuable assortments of varieties that would respond to the current climate conditions in the area and by taking into account the other biological and technological factors, they would achieve the genetic characteristic of the variety within the species.