

Research regarding the influence of the variety and some technological measures on the growth and fructification of the blueberry plants in Karditsa area- Greece

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Summary

Blueberry culture presents more and more interest due to the nutritive and pharmaceutical value of the fruit and plant. Blueberries are used as consumption fruits or as raw material for the food industry: jam, jelly, alcoholic blueberry drink, liquor, juice etc.

Research have demonstrated the blueberries play an important role within the human organism: they ensure protection for the brain against the stress and damages caused by neurodegenerative diseases, strokes or aging, they play a role in the proper functioning of the blood flow, ensure eye sharpness, protect the urinary system and the digestive tract etc. These protective effects are due to the fruit's antioxidant and anti-inflammatory properties of some substances from the fruit and leaves of the blueberry plants.

From an economic point of view, this species is more and more of interest also due to the revenues that can be achieved when the culture is properly maintained and benefits from favorable pedo-climatic conditions. The current tendency is to extend the blueberry plantations across many countries that do not traditionally have this culture, both in Europe and on other continents.

Greek economy has been recently met with disagreements and problems caused by the crisis: increase in unemployment, salary decrease loss of taxes and tax evasion are elements that affect the rural economy and the production. All these have led to researching for alternative solutions and cultures that would bring economic and health benefits. The study is also focused on identifying the reasons that led to farmers choosing alternative productions and on what would happen in the future with this culture. Amongst the cultures accepted as alternative possibilities to the traditional production we can mention also blueberry culture, as it is considered an advantageous species for the producer: the production makes a good sale, there is such a market and it ensures important revenues per unit of area.

This was also the motivation for choosing as doctoral theme the blueberry culture in Greece, with two culture variants – in field and in container, in order to see if the results obtained for the studied area (proximity of Karditsa, Thessallia province) confirm the statements about this species made by the few previous studies.

The purpose of the present research was to find an answer to the following question: can blueberry plants be economically efficiently cultivated in the chosen area? Fruits are demanded

especially in the restaurants that ensure quality, comfort and diversity for the consumption offer, where the demand is for qualitative products and for a longer period of time.

For the present paper, a major goal was established – to study the manner in which some blueberry varieties behave within the pedo-climatic conditions of the Karditsa area, from the point of view of the growth and fructification capacities. In order to achieve this major goal, several specific objectives were established:

- The behavior of some blueberry varieties for the culture in field within the pedo-climatic conditions of the Karditsa area, from the point of view of the growth and fructification;
- The behavior of some blueberry varieties for the culture in pots, within the culture conditions from the urban area, on two locations with different exposures, in order to study the plants' reaction to insolation;
- Testing the behavior of some blueberry varieties for pruning at different intensities;
- Testing the behavior of some blueberry varieties for efficient water capitalization;
- Testing the behavior of some blueberry varieties for the combined influence of the two factors;
- Testing the quality of dehydrated fruits depending on the dehydration method.

For the present study, five varieties were used: Duke, Draper, Patriot, Brigitta and Elliott, the first four for the culture in field, while for the culture in container the Duke variety was replaced with Elliott, due to reason related to the same age seedling material available at the start of the experiment.

Experiments were conducted in field and in container; the ones in field focused on the behavior of four varieties for two pruning actions and two watering possibilities, while the one in container focused on the plants' reaction to the full sunlight or semi-shadow conditions.

The experiments was organized as subdivided parcels, each variant being represented by 5 plants that were measured. Measurements focused on the ongoing of the phenological phases, plant growth and fructification.

The quality characteristics of the variety and irrigation water were normal for the farming cultures, but for the blueberry pH had a value slightly higher than the maximum accepted by the plant and so, for this culture, an acidifying agent was used in the water three times a year, of 1,5 l/ha Nutex black, a product with pH 4, to avoid an increase in the soil reaction during the exploitation of the culture.

The obtained results showed a good behavior of the chosen varieties, but slightly different depending on the ensured culture conditions and on the climatic year.

Results regarding the experiment with plants in container

For the two experiments in container, 35 l black pots were used, in which culture substrate was put, made of 40% black peat with a pH of 5,5 , 40% blonde peat pH 3,5% and 20% pearl stone, and afterwards 2 year old blueberry were planted. The culture was set up with fertilization-irrigation system, with 20 mm tubs and drainer with watering capacity of 2 liters/hour. Irrigation was done daily with 2-3 liters of water depending on the temperature, while the fertilization was done with complex fertilizer, every two weeks, 20g/plant, until august.

For the setup of the blueberry in semi-shadow conditions, the plants behaved normally according to their age. The growth and ramification capacity of the plants was different depending on the variety and changed in time with as the plants grew. The varieties Draper and Elliott had a higher ramification capacity, while the varieties Patriot and Brigitta had a lower capacity. For all varieties, as time passed, it was observed that the ramification capacity improved, while amongst the varieties, Draper and Elliott had a slightly higher capacity to form shoots from the parcel. The growth of annual branches was influenced by the plants' age and the variety, Draper and Elliott having a slightly higher growth than the other two varieties.

The fructification capacity increased from one year to another as the bush formed; in the third experimental year, the average production of the varieties was approx. 1032 g fruit/plant, with a maximum value of 1223 g for Draper and a minimum of 860 g for Patriot.

For the plants placed in full sunlight, the growth was slower and their yield was lower, from the production point of view. Even though the experiment had an irrigation system, the heat during the day and the dry air sometimes let to slight phases of water deficit, which induced stress for the plants and led to weaker results compared to the plants placed in semi-shadow.

Results regarding the culture in field

For the culture in field, the effect of pruning on the plants was studied and also the reaction of the four varieties to these interventions. The varieties reacted differently, depending on the analyzed parameter. The growth in height of the plants was directly influenced by the more severe pruning for three of the varieties out of 4, as it happened also with the average length of the annual branches. The variety had a specific influenced biological determined; usually when the ramification capacity was lower, the length of the annual branches was higher. The sum of the annual growths, which includes the vegetative growth of the entire plant, was different; the highest growth was recorded for the Patriot variety and the lowest for Duke, while Draper and Brigitta had intermediary values.

The production capacity was influenced by the biological factor, by the performed pruning and by the climatic year, and the average data obtained per variant showed that Patriot recorded the highest production of approx. 4,8 kg/pl for the more intensive pruned variant in the third year, while the lowest production was obtained during the first year for Patriot, normally pruned variant, of only 1,4 kg/pl.

Average fruit weight was influenced by the variety, climatic year and applied variant; the average value per variety and during the experiment showed that Duke has the largest fruit, of 1,65 g, followed by Brigitta with 1,62 g and Draper with 1,41 g. As range, fruit size varied between 2 g for Brigitta for more intense pruned plants and 0,96 g for Patriot.

Average yield for the production per unit of area showed that the studied varieties had a good behavior, the values having limits of 6,8 t/ha for Duke, normally pruned plants, and 11,3 t/ha for Patriot, intense pruned plants.

If it were to analyze the cumulated effect of pruning and supplementing the irrigation water, it could be noticed that also in this case the plants had a different behavior. Plant growth (height, ramification capacity and length of annual branches) was influenced by the more intense pruning. The additional water did not have a significant influence, but in terms of physical values, in general, the biometric parameters were higher than for the variant without the additional water.

For the experiment with additional water, it was observed a strong influence of the climatic year on all analyzed parameters. The climatic year of 2018 was earlier and with more water from rainfall during spring, which positively influenced the growth process compared to 2017.

Average fruit weight was influenced by the pruning variant, generally more intense pruning determined the formation of larger fruit, and less influenced by the additional watering. For many variants, the additional water led to forming smaller fruit.

The comparative analysis for the same level of pruning for normally watered plants and additionally watered plants showed a very different reaction of the varieties. Larger productions were recorded for the variants without additional water, the differences being generated by the intensity of the pruning and not by the quantity of water. So it can be concluded that a culture technology cannot be used generally for all varieties, but it has to be known and taken into consideration the characteristics of the variety when establishing the culture technology.

Average fruit weight was influenced by the pruning and quantity of water, with different results depending on the variety; for Brigitta it was observed a quantitative cumulating of the two technological factors that influenced fruit size, which increased its value from the first to the last variant continuously.

The climatic year had a large influence on the experiments conducted during 2016-2018, at least from the production point of view for the pruned experiment, the year 2017 being the most

productive. For the experiment with additional water, the year 2018 was the best for the majority of the analyzed parameters both regarding the vegetative growth as well as the fructification. From this it can be understood that not only the technology influences the result obtained in the orchard, but also the climatic conditions that the man can little influence.

In what regards the determined correlations, for the pruned experiment, there were highlighted relations of direct dependency between the sum of total growths and the production, between the length of annual branches and production, and correlations inversely proportional between the average fruit weight on one hand and the sum of annual growths and average length of annual branches on the other hand.

For the experiment with pruning combined with additional irrigation positive correlations were observed between the production on one hand and the sum of annual growth and length of fruit branches on the other hand, between the sum of total growth and number of inflorescences and a strong negative correlation between the number of inflorescences and average fruit weight.

The quality of dehydrated fruit was different according to the dehydration method. For the artificial dehydration with heat, the fruit had a higher content on vitamin C and of polyphenols, while the naturally dehydrated fruit had a higher antioxidant capacity and a higher content of anthocyanins and flavons. Moreover, naturally dehydrated fruit had a higher content of magnesium, iron, zinc and molybdenum, which helps the human organism in cases of disorders and deficiency of these elements.

The economic efficiency showed the profitability of these four varieties cultivated in field, even though the influence of the culture technology was different, for each variety the net revenue calculated is more than satisfactory, which encourages or should encourage more and more producers to move towards this important fruit growing species. In terms of values, the amounts that can be obtained are at least 12700-24800 euro for the Duke variety, 21500-24500 euro for Draper, 24000-37000 euro for Patriot and 23000-31000 euro for Brigitta.