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EVALUAREA NOILOR SOIURI DE AFIN ÎN CONDIȚIILE PEDOCLIMATICE DE LA ICDP PITEȘTI-MĂRĂCINENI

EVALUATION OF NEW BLUEBERRY CULTIVARS IN PEDOCLIMATIC CONDITIONS FROM RIFG PITESTI-MARACINENI

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Abstract

***Vaccinum corymbosum* is one of the species highly valued for the taste and dietary value of its berries. The new blueberry cultivars obtained in the breeding activity have high productivity, resistance to diseases and pests, and large and easily removable fruits. The success of the extension of blueberry crops depends on the adaptability of the cultivars to soil conditions and regional climate changes. A study was carried out at the Research Institute for Fruit Growing Pitesti-Maracineni, in the period 2019-2022, and was focused on the vegetative growth and fruiting processes, berries quality, and evaluated the disease and pest behavior of 13 new blueberry cultivars, currently in their 4th year ('Top Shelf', 'Blue Ribbon', 'Calypso' and 'Valor'), respectively 6 years from planting ('Duke', 'Bluejay', 'Draper', 'Liberty', 'Elliott' and 'Aurora'). The ripening period of the new cultivars covered a period between the second decade of June (12.06.2020, 'Duke') and the end of August (27.08.2021, 'Aurora', 'Last Call' and 'Elliott'). Depending on the age of fruit ripening, the cultivars were divided into very early ('Duke'), early ('Huron'), early-middle ('Blue Ribbon', 'Draper', 'Bluejay'), middle ('Top Shelf', 'Valor', 'Calypso'), late ('Cargo' and 'Liberty') and very late ('Last Call', 'Elliott' and 'Aurora'). At the end of the four years of study, the analysis of the data recorded for the vegetative growth and fruiting processes indicated that, for the younger plants (4th year after planting), for an average bush volume of 0.41m^3 (0.14- 0.84 m^3) berry yield fluctuated around 7.27 t/ha (1.66-16.59 t/ha). The cultivars with superior vigor were 'Valor', 'Last Call', and 'Cargo' (0.49-0.53 m^3), the most productive being 'Cargo', with approximately 13.6 t /ha. For blueberry in the 6th year after planting, where the average volume of the bush was 0.53 m^3 (0.19-0.82 m^3), the fruit production was 6.89 t/ha (1.87 -14.4 t/ha). The cultivars with superior vigor were 'Bluejay', 'Aurora' and 'Liberty' (0.59-0.62 m^3), and in terms of productivity, 'Duke' (9.13 t/ha) and 'Liberty' stood out (9.92 t/ha). For plants of the same age (3 and 4 years after planting), the average berry weight fluctuated around 2.25 g (0.7-5.72 g), the firmness recorded an average of 43.95 (15.9-77.50 units), while juice pH and total soluble substance content showed average values of 3.44 (2.24-5.72) and 13.32˚Brix (7.9-23.40). The highest berry weight was determined for 'Top Shelf' cultivar (2.9 g). The cultivars 'Aurora' and 'Last Call' stood out for their superior content of total soluble solids (17.14 and 16.01˚Brix), and the cultivars 'Blue Ribbon' and 'Top Shelf' for their high fruit pH (4.18 and 3.69). Last but not least, the high firmness of the fruits highlighted the Aurora and 'Blue Ribbon' cultivars (57.90 and 52.28 HPE-II-FFF Bareiss units). Regarding the phytosanitary status of the studied shrubs, increased sensitivity to diseases of the 'Huron' cultivar was highlighted (ISV 2.9%), especially to the attack of *Phytophthora* spp. (1.6%attack degree), which influenced significantly plant survival. At the end of the study period, we can recommend the cultivars 'Duke', Liberty', and 'Cargo' for cultivation in similar pedoclimatic conditions, the first standing out for its earliness and productivity, and the last two for their high fruit production.**

Cuvinte cheie: fenologie, adaptabilitate**,** evaluare fitosanitară, productivitate, calitate a fructelor.
Key words: phenology, adaptability, phytosanitary evaluation, fruit yield, fruit quality.

1. Introduction

High bush blueberry (*Vaccinum corymbosum* L.) is one of the horticultural species that have become a major crop worldwide (Strik and Finn, 2008). Its cultivation has spread from North America to the whole world, encouraged firstly by its adaptability to a diversity of climatic conditions and secondly by its organoleptic attributes and the dietary value of its berries. Related to this last aspect, of great interest is the functional food quality of blueberries, correlated with the composition of their polyphenols, especially anthocyanins, which are responsible for a series of activities such as antioxidants, reducing the level of plasma lipids and carbohydrates and insulin resistance (Kalt et al., 2020). Through the lens of these biological implications, blueberries belong to the valuable group of fruits whose consumption

correlates with protection against cardiovascular disease, type 2 diabetes mellitus, and neurological decline (Kalt et al., 2020).

Cultivars covering a wide range of climatic conditions, starting times in vegetation, flowering, and fruiting have been introduced into the culture. Differences between cultivars were also mentioned in the literature regarding fruit production (Silina and Liepniece, 2020) and, therefore, economic efficiency.

Blueberry has special soil requirements. Due to the mycorrhizae at the level of the root system, it needs an acidic substrate, with a pH varying between 4.5-5.8, depending on the properties of the soil. Moreover, significant influences of plant substrate (Mladin et al., 2011) and soil pH on fruit production of some blueberry cultivars have been documented (Silina and Liepniece, 2020). It is also sensitive to root asphyxiation, preferring well-drained soils. In the absence of a suitable substrate, these requirements can be satisfied (with good results in particular regarding the supply of N, O, and Mg to the plants), by using peat (Kingston et al., 2020). In addition, planting on raised beds, a mixture of soil and peat, covered with agro-textile to prevent problems related to soil drainage, and evaporation of water from the substrate and helps to manage the weed along the plant rows, especially in the first 4 years after establishing the culture.

By applying adequate orchard technology, some plant characters can be optimized and suitable conditions can be created for the cultivation of the species even in less favorable areas from the pedoclimatic point of view. However, the success of the expansion of blueberry crops depends on the ability of the cultivars to adapt to the pedological conditions and regional climate changes, but also the ability to preserve the qualities with which they were genetically endowed in the situation of the additional stress generated by the location in a new natural setting.

Starting from these considerations, the present study evaluated the fruiting process, the vigor of the bushes, the quality of the fruits, and the diseases and pest behavior of 13 new blueberry cultivars in the Central-Southern area of Romania.

2. Material and methods

2.1. Vegetal material

A completely randomized single-factor experiment (with two plants, in three repetitions for each cultivar) was carried out in the Central-Southern part of Romania, at the Research Institute for Fruit Growing Pitesti-Maracineni during 2019-2022. The subject of the paper is the study of 13 blueberry cultivars. The plants belong to two different study groups: the first group planted in 2017 (A plot), represented by the cultivars 'Duke', 'Huron', 'Bluejay', 'Draper', 'Liberty', 'Elliott' and 'Aurora ', which were followed for 4 years, between years 3 and 6, and the second group, represented by the cultivars 'Top Shelf', 'Blue Ribbon', 'Calypso', 'Cargo' and 'Valor', was planted two years later in 2019 (B plot) and studied for 4 years, between the first and fourth year after planting. 'Huron' cultivar (planted in 2017) was only discussed regarding its phytosanitary status, based on the recommendations at the end of the study. The 13 cultivars were created at the Fall Creek Nursery in Oregon, United States, and the planting material was obtained by in vitro propagation. The study presents for each group, in dynamics between the years 2019 and 2022, data related to fruit quality. It also analyses bush vigor, fruit production, and the correlations established between the two indicators within the studied blueberry plots. Last but not least, to make a comparison between the 13 cultivars regarding the production and the quality of the fruits, the age of the plants (years 3 and 4 after planting) was chosen as a common element.

The blueberry planting was carried out at a distance of 3 m x 1 m, on raised beds containing a mixture of soil and peat and covered with black agro-textile. The intervals were seeded with *Lolium perenae*, which was periodically mowed and used as green manure. For each row of plants (representing a single cultivar), the necessary water and mineral elements were ensured by a drip irrigation system located above ground (placed under the agro-textile), with 2 watering tubes for each row of plants, equipped with pressure compensated droppers disposed at a distance of 30 cm from each other. The doses of nutrients administered to the experimental blueberry plots were established based on the SMART Fertilizer program, for a calculated depending on the expected harvest.

2.2. Methods

Data related to climatic factors were recorded using WatchDog 2900ET (Spectrum Technologies) and iMetos ag (Pessl Instruments) automatic weather stations. The monthly and annual averages of the minimum, average, and maximum daily temperatures were calculated, as well as the monthly and, respectively, the annual sum of the sunshine hours and atmospheric precipitation.

The studies referred both to the processes of growth, fruiting, and fruit quality, as well as to the behavior of cultivars when attacked by pathogens and pests. Cultivars' vigor was appreciated based on the aerial part volume of the bushes. For this, the aerial part of the bushes was considered an inverted cone trunk, covered by a spherical cap (Fig. 1), and its volume was therefore calculated based on the maximum and minimum height and the two diameters of the bushes (measured respectively parallel and perpendicular to the direction of the row).

Berry yield was determined by weighing the fruits harvested on each of 6 randomly chosen bushes per cultivar and multiplying by the number of bushes corresponding to a one-hectare area (3333). The quality of the fruits was described by the average values of the indicators fruit mass, firmness, pH, and total content of soluble substance, determined on 3 samples of 30 fruits each, randomly chosen from 500 g samples collected from the 6 bushes. Sampling was carried out in three moments, at the beginning, middle, and end of the harvesting period, and laboratory determinations were carried out immediately after sampling. Berry weight was measured by weighing each sampled fruit individually using a Kern electronic balance. A penetrometer equipped with a 2 mm diameter flat probe was used to determine firmness, and the results were expressed in HPE-II-FFF Bareiss units. The total soluble solids content, expressed in Brix degrees, and the pH of the fruit juice were determined with a Kern refractometer and a Mini-Lab pH meter.

The behavior to the pathogens' attack and pests was evaluated by the specialists of the Phytosanitary Protection laboratory and, based on the recorded data, the degree of attack and the varietal sensitivity index of each cultivar were calculated.

Data were statistically analysed using ANOVA and Duncan's multiple comparisons test at a significance level α of 0.05. One-way ANOVA was used in the analysis of growth and fruiting processes, as well as in the comparative study of fruit quality for the plants of the two groups in the 3rd and 4th years after planting, and Two-way ANOVA, in the detailed study of the effect of the cultivar depending on the experimental year on the fruit quality in each of the two plant groups. Correlations between bush vigor and fruit production, as well as correlations between production and fruit mass, were plotted using regression curves.

The presentation of the results initially focused on each of the two groups with different planting moments. Secondly, although there is undoubtedly an influence of climatic factors on the physiological processes of the blueberry, to outline an overall picture, a comparative study of the cultivars with similar ages, respectively the years 3 and 4 from planting were performed.

3. Results and discussion

Description of the pedoclimatic conditions in the area where the experiment was located

The climate of the area where the studies took place is temperate-continental, with an average annual temperature of 10°C. In the last 52 years, during the winter the absolute minimum dropped to -24.4°C, and the average minimum reached -5.1°C in January. In summer, the maximum temperature rose to 38.8 °C, while the average maximum of the hottest month (July) was 28.0 °C. The duration of sunshine during a year was 2261.2 hours and varied between 90 hours in December and 304 hours in July. The average annual precipitation has reached the sum of 677.8 mm, with large oscillations from one year to the next. The highest amount of precipitation frequently falls in May and June.

To highlight the thermal favourability of the Maracineni-Arges area for blueberry culture, the two diagrams presented in Fig. 2 were used, which show the dynamics of the average pentadal number of hours in the day between the species' cardinal temperatures. As can be seen, the blueberry finds in the Maracineni-Arges area an environment adequate to its cultivation, where the temperatures do not exceed the extremes of the species (the frost resistance limit of -36°C and the absolute maximum of 42°C, Coman and Chitu, 2014). Moreover, during the hottest periods of the year, the number of hours of the day with temperatures between the optimal maximum and the absolute maximum is reduced, being on average no more than 4 and reaching 5 in exceptional situations, as represented in the year 2020.

The assortment of the studied cultivars was selected to cover a wide harvest interval as possible. The fruit ripening period of the new cultivars was between the second decade of June (12.06.2020, 'Duke') and the end of August (27.08.2021, 'Aurora', 'Last Call' and 'Elliott'). Depending on the age of fruit ripening, the cultivars were divided into very early ('Duke'), early ('Huron'), early-middle ('Blue Ribbon', 'Draper', 'Bluejay'), middle ('Top Shelf', 'Valor', 'Calypso'), late ('Cargo' and 'Liberty') and very late ('Last Call', 'Elliott' and 'Aurora').

The descriptive analysis of the data registered for the volumes of the bushes and berry yield in the two blueberry groups (planted in 2017 and, respectively, in those planted two years later) is presented in Tables 1 and 2. It can be seen that, unlike group B, in group A (planted in 2017) most of the bushes showed aerial parts volumes higher than average, while in both groups fruit production was most frequently below average. Also, for both indicators, wider oscillations were recorded in young plants (plot B, Table 2). In addition, given that the average volume of the bushes of 4-year-old plants was significantly lower compared to the volume of 6-year-old plants, the yield achieved by the two groups of plants showed no statistically significant differences ($p>0.05$).

The average values recorded for the berry weight and the total content of soluble matter varied from 1.68 g (batch A) to 2.42 g (plot B), respectively from 13.27 (plot B) to 14.76 Brix degrees (plot A), in both cases the differences being significant. The firmness of the pulp presented averages of 45.38 units

(plot A) and 43.96 units respectively (for plot B), and the pH of the juice recorded averages of 3.49 (plot A) and 3.47 (plot B), respectively.

Influence of the cultivar on the bush volume and fruit production in the 6th year after planting

Most of the cultivars planted in 2017 (Figure 3) showed high (0.59-0.26 m^3) and average bush vigor (0.52 m^3), the least vigorous being the 'Draper' cultivar (0.40 m^3). Regarding berry yield, in the last year of experimentation, the most productive cultivars were 'Duke' and 'Liberty', followed by 'Aurora', the production of the 'Draper' cultivar, similar to vigor, being the lowest.

The correlation between production and the volume of the aerial part of the bushes for cultivars in the 6th year after planting (Figure 4) is distinctly significant, positive, and linear. It is noted that, at an average increase of the bush volume of 0.1 m^3 in the range of 0.2 - 0.85 m^3, berry yield increased by 0.88 t/ha in the 3-10 t/ha interval.

Influence of the cultivar on the volume of the bush and berry yield for the cultivars in the 4th year after planting

As shown in Fig. 5, among the cultivars planted in 2019, the most vigorous were 'Valor' (0.49 m^3), 'Last Call' (0.50 m^3), and 'Cargo' (0.53 m^3). Among them, the 'Cargo' cultivar stood out for its high berry yield (13.56 t/ha), followed by the medium-producing cultivars Valor (7.29 t/ha), 'Last Call' (8.27 t/ha) and 'Calypso' (8.92 t/ha).

The correlation between berry yield and bush volume (Fig. 6) was in this case very significant positive and linear. At an average increase of the bush volume of 0.1 m^3 in the range of 0.1 – 0.85 m^3, fruit production increased by 2.1 t/ha, between 2-16 t/ha.

Influence of the cultivar on fruit quality, depending on the study year, in the period 2019-2022

A concern of the present study was also related to how the fruit quality (i.e., the indicators of fruit mass, pulp firmness, juice pH, and total soluble substance content) varied in each cultivar from the two plots, during the four years of research.

Thus, among the **cultivars of the plot planted in 2017**, in the period 2019-2022, the 'Draper' cultivar stood out due to the high weight of the berries (1.99 g), followed by 'Duke' (1.86 g) and 'Aurora' (1.81 g) (Fig. 7). The 'Draper' and 'Duke' cultivars are highlighted by high and medium-high values of this character in the study years 2019, 2021, and 2022. For 'Aurora' cultivar, the berry weight was high in 2020 and 2022 and showed low values in 2019 and 2021. An exception, compared to the trend recorded for the four years, was the 'Liberty' cultivar, with large fruits, similar to the 'Aurora' cultivar, in the last year of the study (1.91 g).

'Elliott' and 'Aurora' cultivars were also noted for the high firmness of the berries (53.10 and 54.14 HPE-II-FFF Bareiss units), while average values of the indicator were recorded for 'Draper' (48.82) and 'Liberty' (47.06) (Fig. 8). The trend was also observed in the years 2022 and 2021, after 2019, in which the highest firmness was determined for the cultivars 'Duke', 'Draper', and 'Bluejay', and 2020, without significant differences between the cultivars. The firmness of the berries of the 'Draper' cultivar is the exception of this group, which presented the highest value in 2022 (60.47 HPE-II-FFF Bareiss units).

The highest pH values (Fig. 9) were determined for the fruits of the 'Duke' (3.71) and 'Bluejay' (3,86) cultivars, alongside which the 'Elliot' cultivar stood out for its high fruit firmness in 2019 and 2022. The firmness differences between the cultivars of the group planted in 2017 were insignificant in the first two years of the study, but more accentuated in the last two.

Similar to the firmness and contrary to the pH trend, total soluble content (Figure 10) recorded the highest values for the 'Elliott' cultivar (16.53˚Brix), followed by 'Aurora' (15,93 ˚Brix). 'Liberty' and 'Draper', were observed in 2022, as exceptions, with 17.12 and 16.31 ˚Brix.

As can be seen in figure F, on the average of the years (2019-2022) within **the blueberry planted in 2019**, the 'Top Shelf' cultivar stood out due to the high weight of the berries (2.91 g), followed by 'Blue Ribbon' (2.59 g), 'Valor' (2.59 g) and 'Calypso' (2.58 g) (Fig. 7). However, in the first two years of the study, the highest berry weights were recorded for the cultivars 'Calypso' (4.41 g, for 1-year-old plants) and Blue Ribbon (3.85 g, for 2-year-old plants). The smallest berries were harvested from the 'Last Call' (1.75 g) and 'Cargo' (1.84 g) cultivars.

Regarding the firmness of the fruit pulp (Fig. 8), the 'Blue Ribbon' cultivar stood out on the average of the study years (49.26 HPE-II-FFF Bareiss units), followed by 'Last Call' (45.05), 'Cargo' (44.28), and 'Top Shelf' (44.07). A variation in the firmness of the cultivars is observed in each of the four years of experimentation, the only constant aspect being the reduced firmness of the fruits of the 'Calypso' cultivar.

'Blue Ribbon' and 'Top Shelf' were the least acidic cultivars, with 4.13 and 3.67 average pH and the lowest pH was registered for 'Cargo' (3.09). 'Calypso' deviated from this trend in 2020, with 3.74 pH (Fig. 9). Except 2019, the highest TSS were recorded for cultivars 'Calypso' (14.47˚Brix) and 'Last Call' (15.86 ˚Brix), while 'Top Shelf' presented the lowest TSS (12.44 ˚Brix) (Fig. 10).

Comparative analysis of the cultivars in plants in the 3rd and 4th years after planting

Without considering the effect of climatic factors unimportant and to be able to make a comparison at present between all the cultivars studied, the decision to present the data of the berry yield and quality recorded for plants of similar age (respectively 3 and 4 years, biannual average values) was made. As represented in the graph in Fig. 11, the highest fruit yields were recorded for 'Elliott' (11.75 t/ha) and 'Aurora' (11.43 t/ha), while the above-average yielding cultivars were 'Duke' (7.35 t/ha), 'Cargo' (7.87 t/ha), and 'Liberty' (9.80 t/ha). The average berry weight was higher for 'Top Shelf' (2.91 g, Fig. 12), in the conditions where the productivity of the cultivar was minimal (1.70 t/ha). Among the cultivars with medium berry weights, 'Duke', 'Blue Ribbon', 'Draper', and 'Valor', the most productive was, as already mentioned, 'Duke'.

The 'Aurora' cultivar stood out in terms of fruit firmness (57.90), followed, in descending order, by 'Top Shelf' (44.61), 'Calypso' (44.48), 'Cargo' (46.61), 'Last Call' (48.12), and 'Blue Ribbon' (52.28 HPE-II-FFF-Bareiss units) (Fig. 13). 'Blue Ribbon' was the cultivar with the highest pH (4.18), and at the opposite pole was the 'Aurora' cultivar (pH 2.97). Above-average pH values were also recorded in the 'Liberty' (3.38) and 'Top Shelf' (3.69) cultivars (Fig. 14). 'Aurora' (17.14˚Brix) was highlighted through its average total soluble content in years 3-4 after planting, while 'Liberty' (13.57 ˚Brix), 'Calypso' (14.22 ˚Brix), 'Elliott' (14.85 ˚Brix), and 'Last Call' (16.10 ˚Brix) cultivars showed above-average total soluble matter contents (Fig. 15).

Blueberry yield and fruit quality varied depending on planting system, soil pH, orchard technologies, plant ages, orchard location, etc. as presented in the literature. Therefore, Strik et al. (2017) reported an increase in fruit production with plant maturity, between the ages of 2 and 7 years, except for 'Duke' cultivar. The results presented were similar to those discussed in our paper. The authors obtained higher cumulative productions (2008-2014) for 'Liberty' (19.6 kg/plant), 'Aurora' (17.9 kg/plant), and 'Duke' (15.1 kg/plant) cultivars compared to 'Draper' (14.2 kg/plant), and 'Buejay' (13.6 kg/plant). Moreover, compared to our results, in Strik et al. (2017) study, the fruit weight was higher for 'Aurora' (2.28 g) and 'Bluejay' (1.75 g), lower for 'Draper' (2.19 g), while similar berry weight was reported for 'Duke' (2.19 g) and 'Liberty' (2.11 g). The authors also reported higher SST content that decreased in the order 'Bluejay' (15.0˚Brix), 'Liberty' (14.5˚Brix), and 'Draper' (14.5˚Brix), 'Duke' (13.5˚Brix), except for 'Aurora' (13.1˚Brix) which had lower TSS than in our research. Strik et al. (2017) reported berry firmness decreasing as follows: 'Draper', 'Duke', 'Aurora', 'Liberty'. Higher berry weight was reported for 'Bluejay' (2.4 g) in northern conditions in Estonia for four-year blueberry plants (Starast et al., 2008). In another experiment, Ehlenfeldt et Martin (2010) recorded for 'Duke' cultivar berry yield varying between 3.5-7.4 kg/plant and berry weight of 1.2-2.3 g (for plants aged 2-12 years), and Milić et al. (2018) recorded for the same variety (3- and 4-year-old plants, grown in containers) productions of 2.06 and, respectively, 1.55 kg/bush, with berry weights of 1.48 and 1.4 g.

The results of the pathogen and pest attack behavior evaluation indicated that the 'Huron' cultivar showed sensitivity to *Phytophtora* spp and *Fusicoccum corymbosum*, 'Top Shelf' cultivar was susceptible to *Phytophtora* spp, and 'Duke' was susceptible to *Colletotrichum acutatum* (Fig. 16). Finally, an ISV of 2.9 was calculated for the 'Huron' cultivar, almost double compared to 'Duke' and 'Bluejay' (Fig. 17). Based on these data, phytosanitary protection specialists considered that there may be reservations regarding the inclusion of the 'Huron' cultivar in the current assortment.

4. Conclusions

During the comparative analysis of plants with similar ages (3 and 4 years after planting), it was observed that the cultivars 'Elliott ' and 'Aurora' had the highest productions, being followed by 'Liberty', 'Cargo', and 'Duke', and by the weight of the fruits, it was noted mainly the cultivar 'Top Shelf ', but also the cultivars 'Valor', 'Draper', 'Calypso', 'Duke', and 'Blue Ribbon'. Among the cultivars with above-average productivity, the highest berry weight was recorded in the cultivar 'Duke', and among the cultivars with above-average berry weight, the most productive was 'Draper'. Blueberry finds in the Maracineni-Arges area an environment adequate to its cultivation. Nevertheless, given the sensitivity to pathogens, caution is recommended regarding the 'Huron' cultivar.

References

1. Bowen C.R. and Hollinger S.E., 2004. Model to determine suitability of a region for a large number of crops. Illinois State Water Survey.
2. Coman M. and Chițu E., 2014. Zonarea speciilor pomicole în funcție de condițiile pedoclimatice şi socioeconomice ale României. Editura Invel Mutimedia, Piteşti.
3. Ehlenfeldt M.K. and Martin Jr R.B., 2010. Seed Set, Berry Weight, and Yield Interactions in the Highbush Blueberry Cultivars (*Vaccinium corymbosum* L.) 'Bluecrop' and 'Duke'.

4. Kingston P.H., Scagel C.F., Bryla D.R. and Strik B.C., 2020. Influence of perlite in peat-and coir-based media on vegetative growth and mineral nutrition of highbush blueberry. HortScience, 55(5): 658-663.
5. Milić B., Tarlanović J., Keserović Z., Magazin N., Miodragović M. and Popara G., 2018. Bioregulators can improve fruit size, yield and plant growth of northern highbush blueberry (*Vaccinium corymbosum* L.). Scientia Horticulturae, 235: 214-220.
6. Mladin P., Chiţu E., Sumedrea M., Coman M., Chiţu V. and Mladin G.H., 2011. Performance of some highbush blueberry (*Vaccinium corymbosum* L.) varieties and promising selections organically grown. Acta Hortic. 981: 237-242.
7. Siliņa D. and Liepniece M., 2020. Variability in yield of the lowbush blueberry clones growing in modified soil.
8. Starast M., Paal T., Vool E., Karp K., Albert T. and Moor U., 2008. The productivity of some blueberry cultivars under Estonian conditions. In IX International Vaccinium Symposium 810: 103-108.
9. Strik B.C. and Finn C.E., 2008. Blueberry cultivars for Oregon.
10. Strik B.C., Vance A.J. and Finn C.E., 2017. Northern highbush blueberry cultivars differed in yield and fruit quality in two organic production systems from planting to maturity. HortScience, 52(6): 844-851.
11. Kalt W., Cassidy A., Howard L R., Krikorian R., Stull A.J., Tremblay F., and Zamora-Ros R., 2020. Recent research on the health benefits of blueberries and their anthocyanins. Advances in Nutrition, 11(2): 224-236.

Tables and Figures

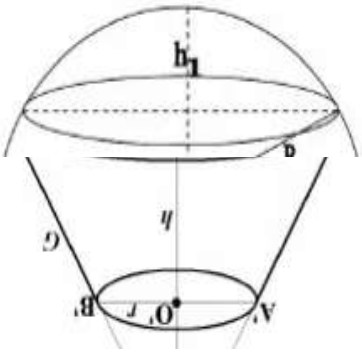

Fig. 1. Graphical representation of the shrub aerial part serving for volume calculation

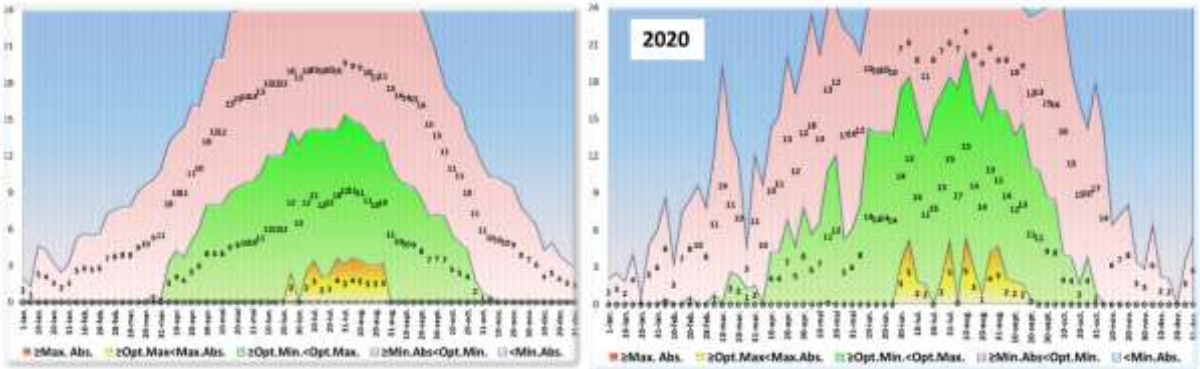

Fig. 2. Dynamics of the average pentadal number of day hours, with temperature between the cardinal points of the highbush blueberry species (7, 18, 30, 42^0 C, for absolute minimum, minimum optimum, maximum optimum, and absolute maximum; Bowen and Hollinger, 2004) – between 1965 and 2020, left and in 2020, right.

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Table 1. Statistic descriptors of blueberry yield and aerial part volume of the bush (in the 6th year from planting) and berry quality characteristics (for 2017 planted blueberry plot)

Statistic descriptors	Shrub volume (m^3)	Yield (t/ha)	Fruit weight (g)	Pulp firmness (HPE-II-FFF Bareiss units)	pH	TSS (Brix grades)
Mean	0.53	6.89	1.68	45.38	3.49	14.76
Median	0.53	6.37	1.61	44.15	3.40	14.50
Std. Deviation	0.16	3.19	0.61	13.52	0.54	2.85
Skewness	-0.08	0.82	0.86	0.34	0.58	0.80
Std. Error of Skewness	0.38	0.38	0.07	0.07	0.08	0.08
Kurtosis	-0.42	0.33	1.26	-0.51	-0.12	0.85
Std. Error of Kurtosis	0.74	0.74	0.13	0.14	0.15	0.15
Range	0.63	12.53	4.40	71.30	3.14	17.70
Minimum	0.19	1.87	0.43	15.90	2.00	7.90
Maximum	0.82	14.40	4.83	87.20	5.14	25.60

Table 2. Statistic descriptors of blueberry yield and aerial part volume of the bush (in the 4th year from planting) and berry quality characteristics (for 2019 planted blueberry plot)

Statistic descriptors	Shrub volume (m^3)	Yield (t/ha)	Fruit weight (g)	Pulp firmness (HPE-II-FFF Bareiss units)	pH	TSS (Brix grades)
Mean	0.41	7.27	2.42	43.96	3.47	13.27
Median	0.39	5.79	2.32	44.40	3.35	12.90
Std. Deviation	0.14	4.62	0.88	10.36	0.61	2.42
Skewness	0.63	0.63	0.75	-0.14	0.88	0.93
Std. Error of Skewness	0.37	0.38	0.06	0.07	0.07	0.07
Kurtosis	0.63	-0.99	0.44	-0.45	0.63	1.36
Std. Error of Kurtosis	0.73	0.74	0.13	0.13	0.14	0.14
Range	0.70	14.93	5.02	56.10	3.48	15.20
Minimum	0.14	1.66	0.70	20.00	2.24	8.20
Maximum	0.84	16.59	5.72	76.10	5.72	23.40

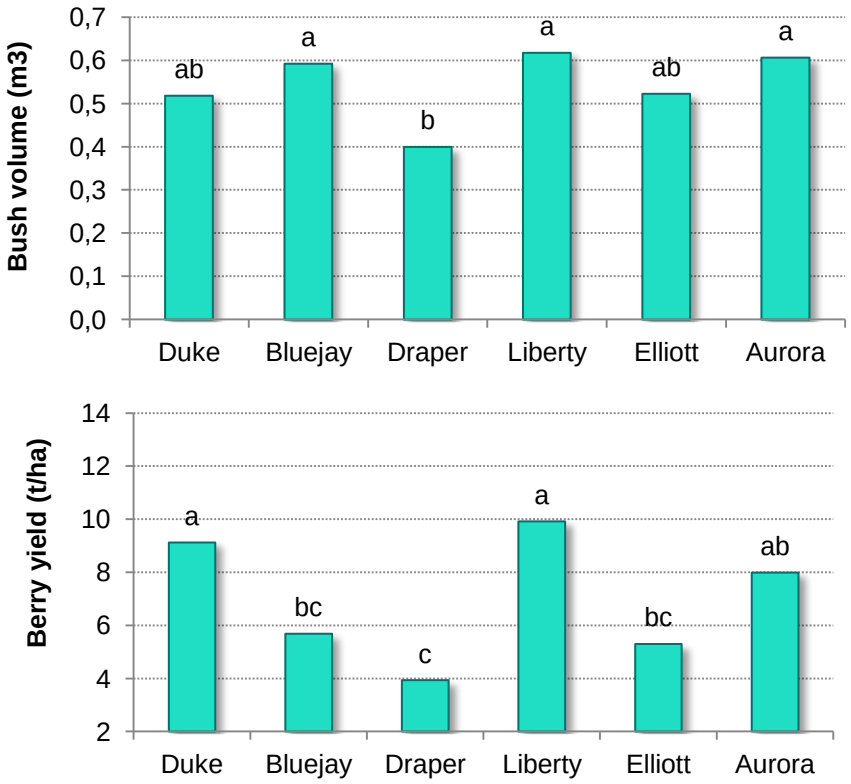

Fig. 3. Blueberry bush aerial part volume (m3)-left and yield (t/ha)-right for the 6th year from planting plot

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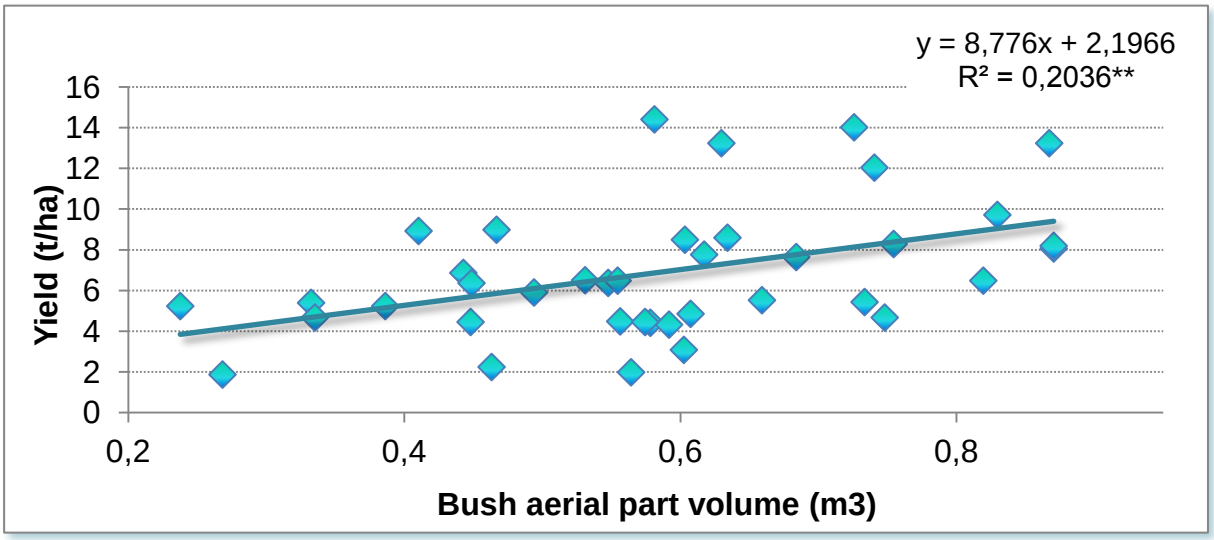

Fig. 4. Correlation between blueberry yield (t/ha) and the aerial part volume of the bush (m3) (in the 6th year from planting)

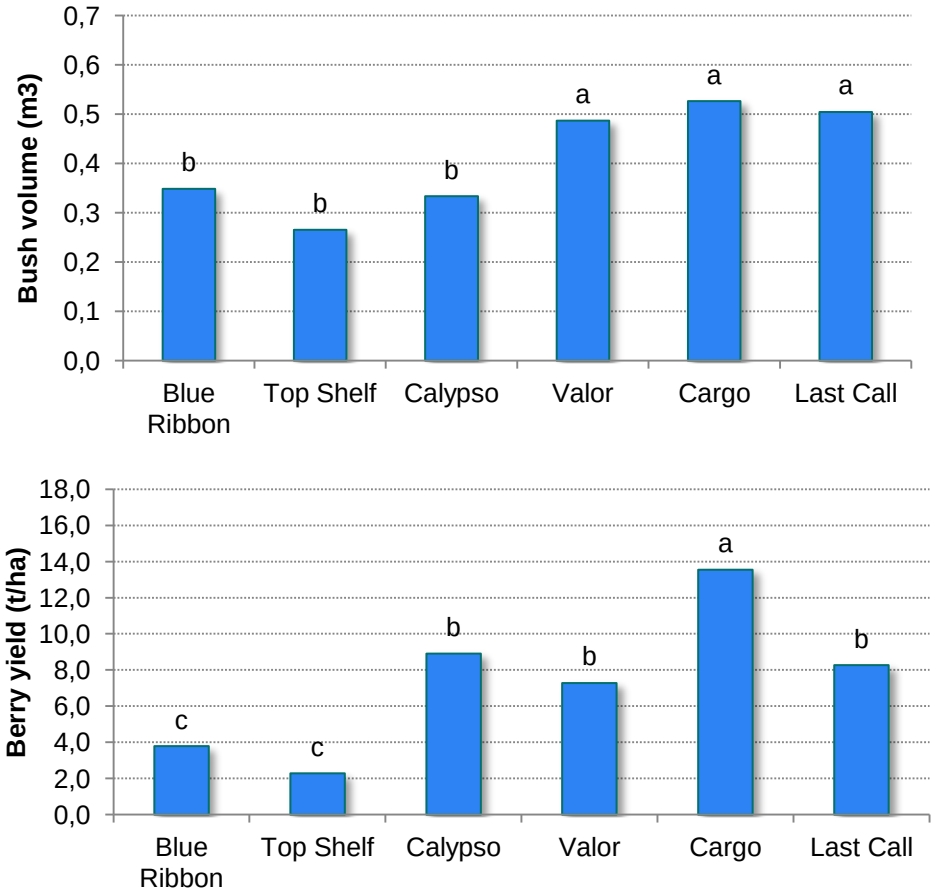

Fig. 5. Blueberry bush aerial part volume (m3)-left and yield (t/ha)-right for the 4th year from planting plot

DOI 10.33045/fgr.v38.2022.14

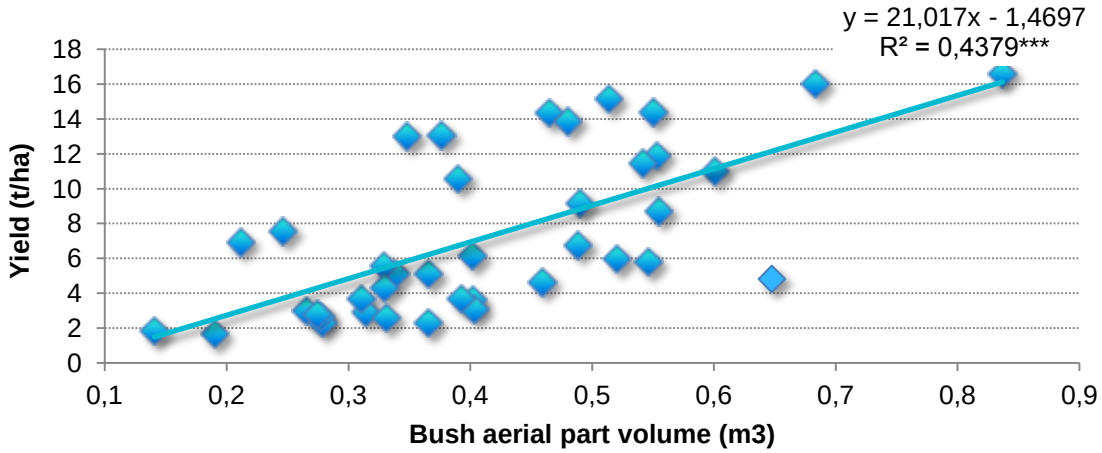

Fig. 6. Correlation between blueberry yield (t/ha) and the aerial part volume of the bush (m3) (in the 4th year from planting)

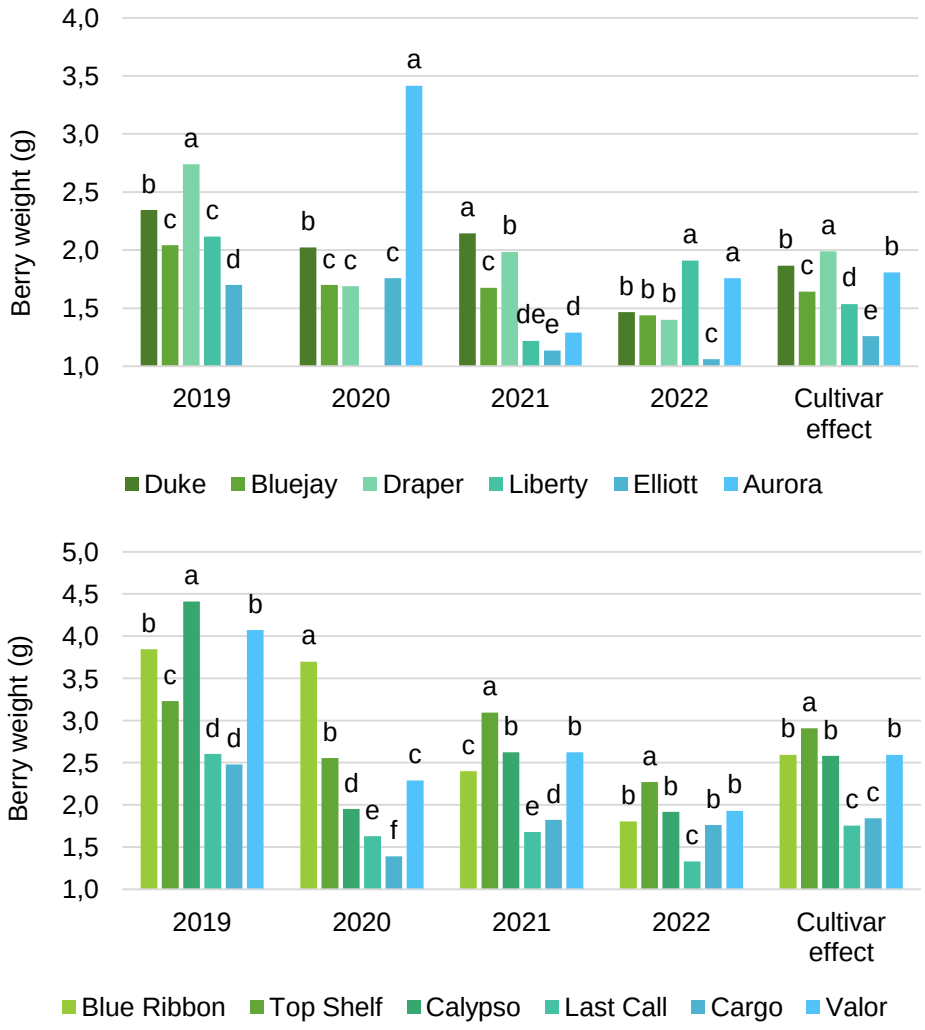

Fig. 7. The influence of the cultivar on the average weight of the fruits, depending on the year of study, in the plants from the two experimental plots (A-left and B-right) in the period 2019-2022

DOI 10.33045/fgr.v38.2022.14

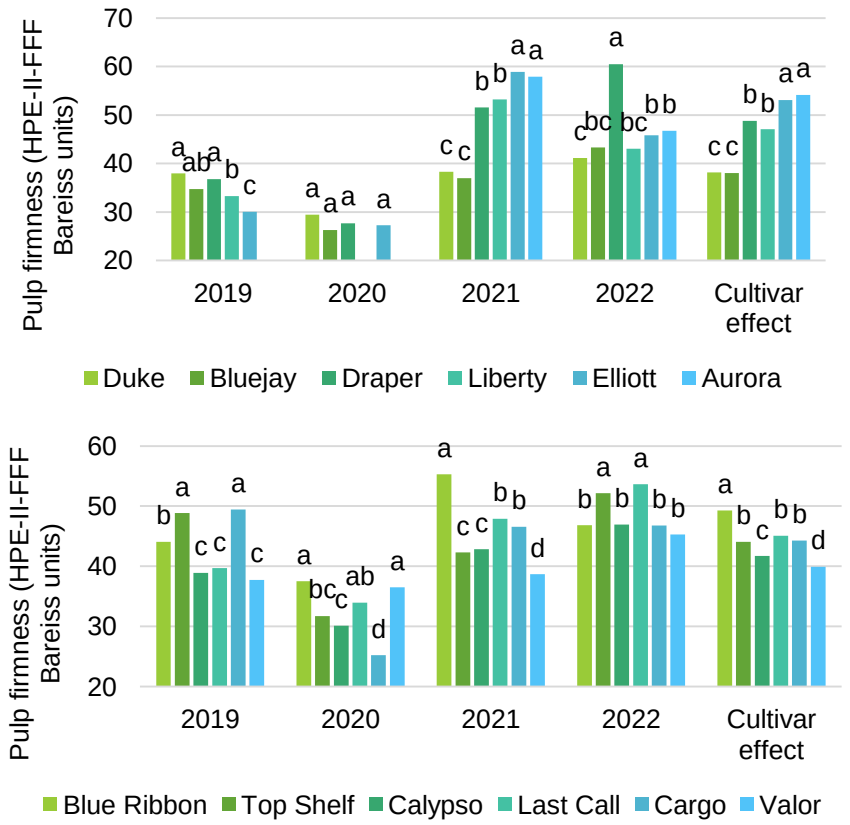

Fig. 8. The influence of the cultivar on the firmness of the fruits, depending on the year of study, in the plants from the two experimental lots (A-left and B-right) in the period 2019-2022

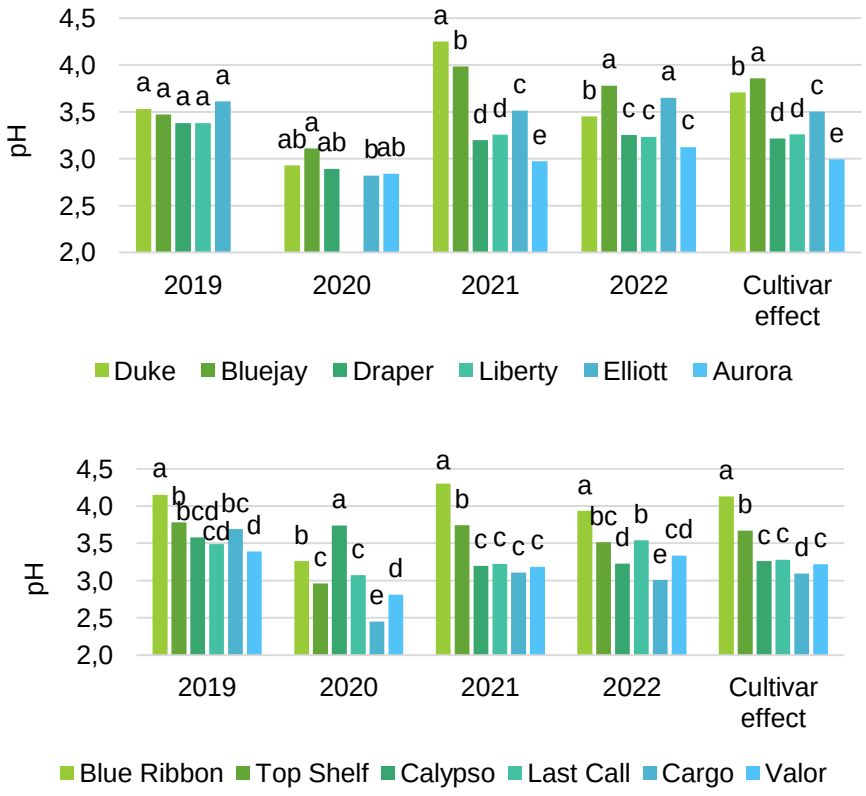

Fig. 9. The influence of the cultivar on the pH of the fruits, depending on the year of study, in the plants from the two experimental lots (A-left and B-right) in the period 2019-2022

 DOI 10.33045/fgr.v38.2022.14

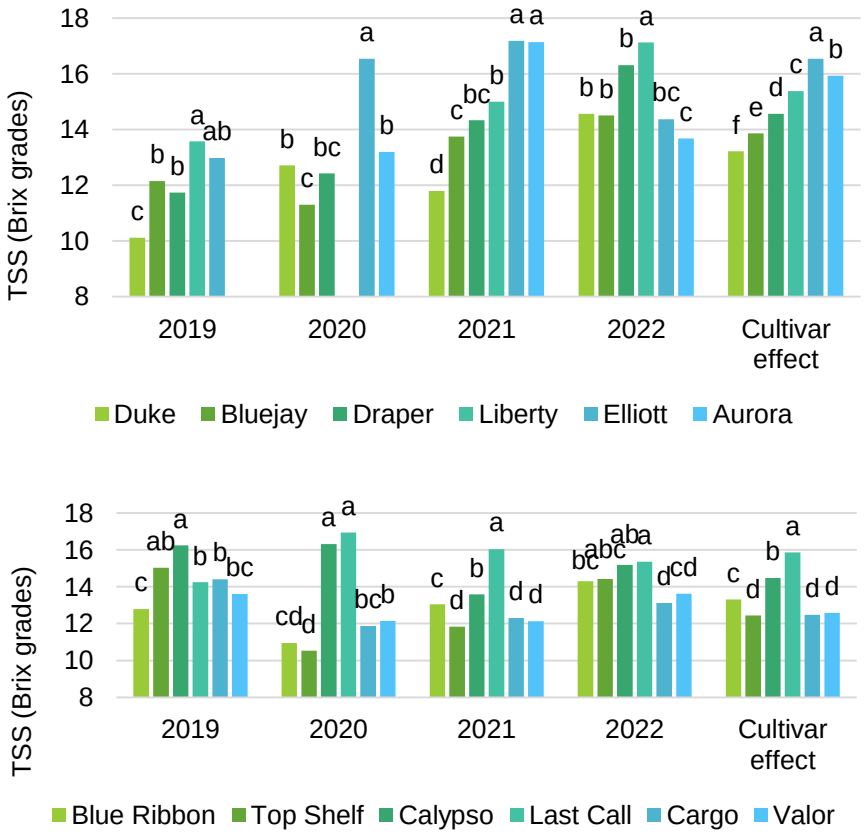

Fig. 10. The influence of the cultivar on the total soluble substance content of the fruits, depending on the study year, in the plants from the two experimental lots (A-left and B-right) in the period 2019-2022

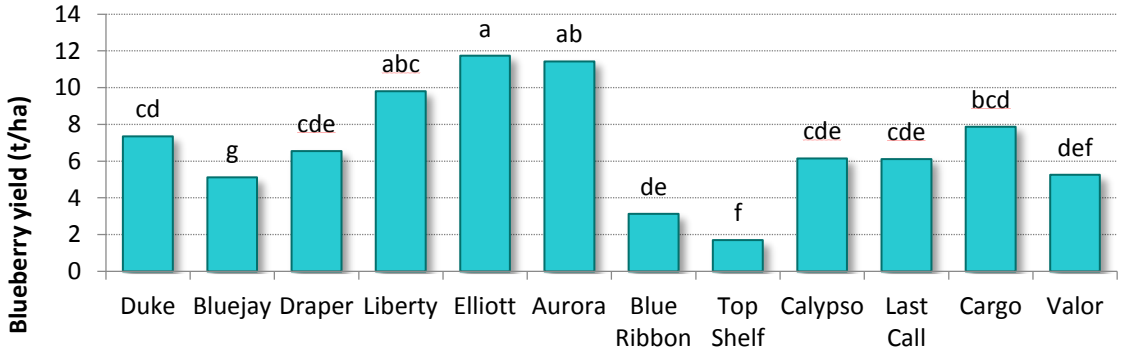

Fig. 11. The influence of the cultivar on fruit production (t/ha) in the 3rd and 4th years after planting

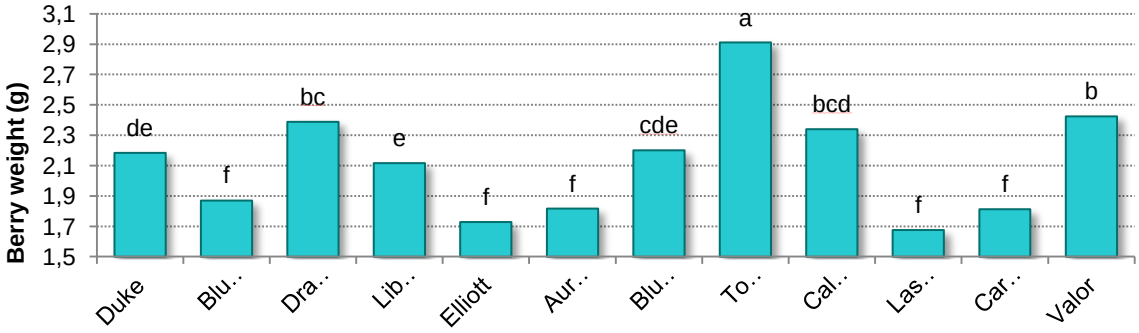

Fig. 12. The influence of the cultivar on the berry weight (g) in the 3rd and 4th years after planting

 DOI 10.33045/fgr.v38.2022.14

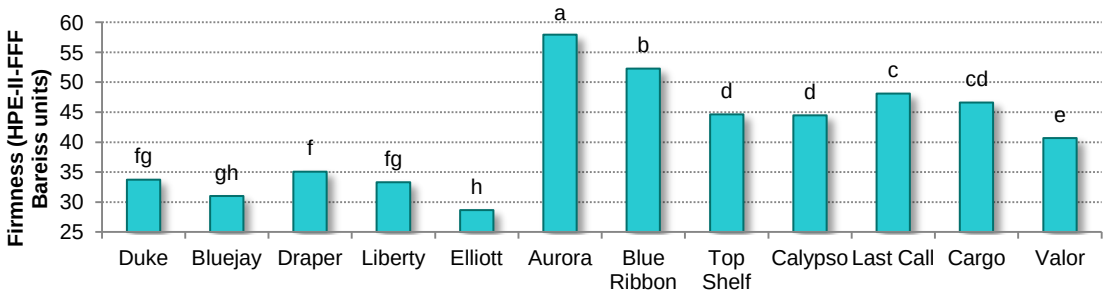

Fig. 13. The influence of the cultivar on pulp firmness (HPE II-FFF Bareiss units) in the 3rd and 4th years after planting

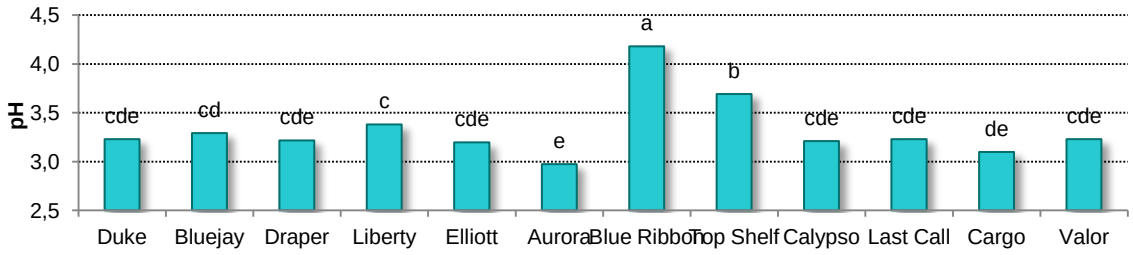

Fig. 14. The influence of the cultivar on the pH of the juice in the 3rd and 4th years after planting

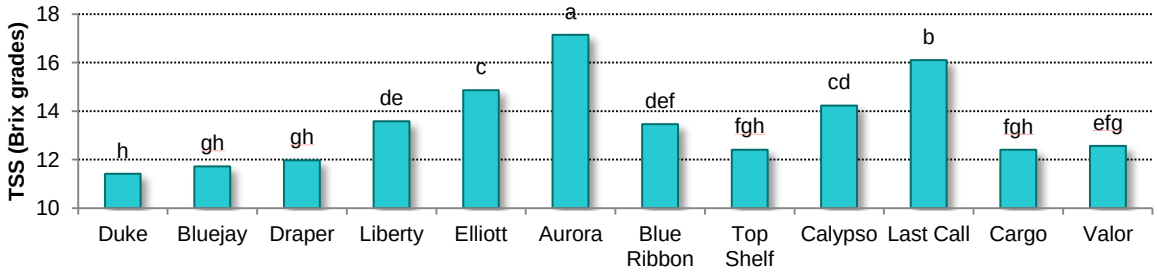

Fig. 15. The influence of the cultivar on SST (degrees Brix) in the 3rd and 4th years after planting

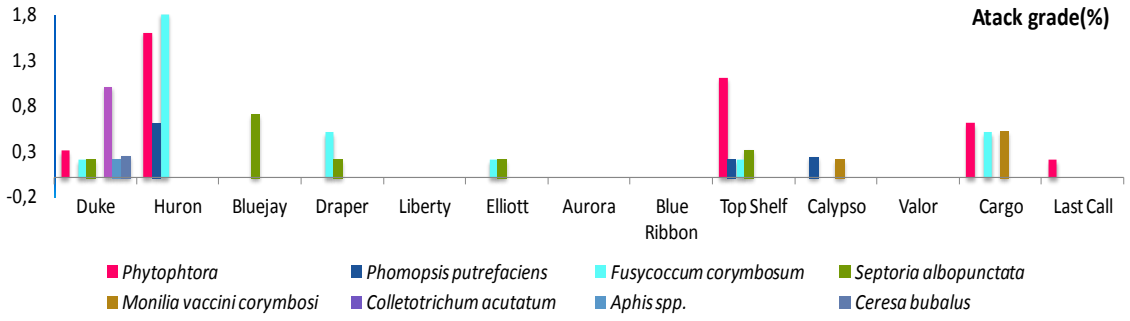

Fig. 16. Graphical representation of attack grade of the studied cultivars

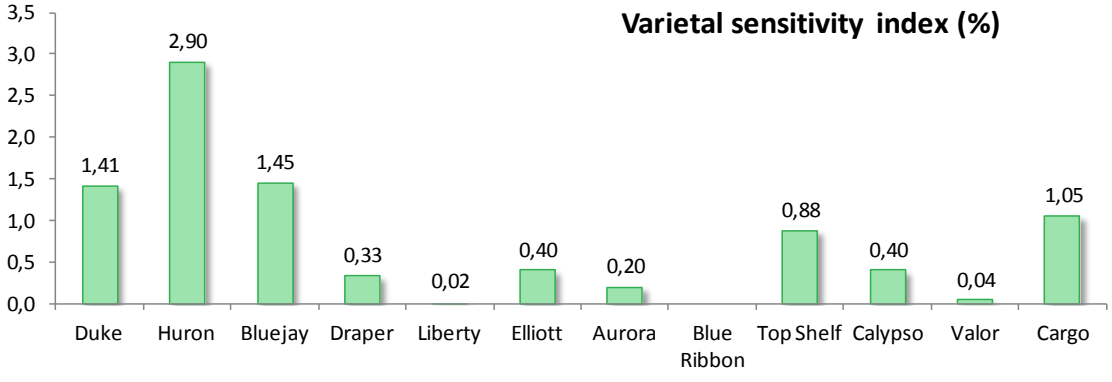

Fig. 17. Graphical representation of varietal sensitivity index of the studied cultivars