Scientific Papers. Series B, Horticulture. Vol. LXX, No. 1, 2026
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

IMPACT OF FERTILIZER TYPES ON VEGETATIVE GROWTH AND FRUIT QUALITY IN BLUEBERRY

Oana HERA[1], Monica STURZEANU[1], Mariana RĂDAC[2]

[1]Research Institute for Fruit Growing Piteşti, 402 Mărului Street, 117450, Pitești, Romania
[2]Institute of Research Development in Mountain Science Cristian, Sibiu, 147, XIII Street, Cristian, Sibiu, Romania

Corresponding author email: sturzeanu1980monica@yahoo.it

Abstract

This study evaluated the influence of different fertilizer types on vegetative growth, productivity, and fruit quality in four highbush blueberry (Vaccinium corymbosum L.) cultivars - 'Simultan', 'Lax', 'Pastel', and 'Blueray'- grown under Romanian conditions. Research was conducted during the 2024 and 2025 seasons in a young plantation established on acidic soil. Fertilization treatments were compared with respect to their effects on plant vigor, yield, and fruit quality attributes, including pH and total soluble solids (TSS). Results demonstrated that fertilizer type significantly affected both vegetative development and fruit quality parameters, though responses varied among cultivars. Certain fertilizer treatments enhanced productivity and improved fruit biochemical composition, while others had neutral or cultivar-specific effects. Overall, findings highlight the importance of fertilizer selection in optimizing growth and fruit quality in blueberry plantations cultivated on acidic soils.

Key words*: different growing condition, fertilization, highbush, Romanian conditions, vegetative growth.*

INTRODUCTION

Highbush blueberry is a high-value small fruit crop that is increasingly cultivated because of its attractive color, desirable flavor, and nutritional benefits. Highbush blueberries originated in North America, and cultivated varieties are classified as either northern or southern types based on their chilling requirements for breaking winter dormancy. Blueberry fertilization has long been a subject of debate. Because blueberries evolved in areas with low nutrient availability, they can survive with surprisingly low levels of fertilization (Banados et al., 2012). However, experience over time has clearly shown that a well-managed fertilization program is essential for rapid growth of young plants and high yields in mature plantings. This is especially true for southern highbush blueberries (Godoy et al., 2008). Blueberry plants are characterized by relatively low nutrient demands compared with many other horticultural crops and are well suited to acidic soils with a pH ranging from 4.5 to 5.5, where the availability of nutrients such as nitrate-nitrogen (NO_3–N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) is naturally limited (Korcak, 1988). Although blueberries are capable of surviving under low-fertility conditions, the application of a well-designed fertilization program is essential to ensure vigorous vegetative growth and the production of high-quality fruit (Hanson & Hancock, 1996; Hart et al., 2006). Nitrogen is the most important nutrient supplied to blueberries and must be applied annually. In contrast to most crops, blueberry plants preferentially take up nitrogen in the ammonium (NH_4^+) form rather than nitrate, largely because of their low nitrate reductase activity in both roots and leaves (Merhaut & Darnell, 1995; Peterson et al., 1988). Nitrogen deficiency typically results in reduced shoot development, pale green to yellow leaf coloration, and in some cases a reddish tint. In addition to nitrogen, blueberries often require supplemental applications of phosphorus, potassium, calcium, magnesium, elemental sulfur (to maintain or lower soil pH), iron, boron, copper, and zinc (Hanson & Hancock, 1996; Hart et al., 2006). Manganese is also essential for plant growth (Larco, 2010) but is generally abundant in acidic soils and therefore rarely limiting (Korcak, 1988). Visual examples of nutrient deficiencies and toxicities in northern highbush blueberry were provided by Ramsdell (1995) and Chen

(2004). Vargas and Bryla (2015) evaluated fertigation versus granular fertilizer applications using different nitrogen sources during the first five years of fruiting in 'Bluecrop' northern highbush blueberry. They observed that granular fertilizers slightly lowered soil pH compared with fertigation; however, plants receiving granular fertilizer also had lower leaf nitrogen concentrations. The highest yields were achieved when nitrogen was supplied through fertigation, particularly using ammonium sulfate or urea sulfuric acid. Similar findings were reported by Ehret et al. (2014) in 'Duke' northern highbush blueberry grown in British Columbia, where fertigation resulted in greater yields while requiring less nitrogen than broadcast fertilizer applications. Together, these studies demonstrate that northern highbush blueberry responds well to fertigation. Although increasing nitrogen rates enhanced vegetative growth in both experiments, higher rates did not increase yield in any year and led to reduced berry size during the early years of production. Overall, annual nitrogen applications of 67-93 $kg \cdot ha^{-1}$ or less were sufficient to achieve optimal fruit production, regardless of whether nitrogen was applied through fertigation or as granular fertilizer.

MATERIALS AND METHODS

Plant material

The study was carried out at the Research Institute for Fruit Growing in Pitesti - Maracineni (RIFG) in southern Romania, located at 44°54'12" north latitude and 24°52'18" east longitude, with an altitude of 284 meters. The study included the following genotypes: -Three Romanians cultivars: 'Simultan', 'Lax' and 'Pastel' cv., obtained from open pollination of 'Spartan' cv. -And 'Bluecrop' - an American-developed northern highbush blueberry (*Vaccinium corymbosum*) cultivar that has been widely cultivated since its introduction in the 1950s. The comparative technological study of different blueberry cultivars, factor A, with the following levels:

- a1 – cultivar *Simultan*,
- a2 – cultivar *Pastel*,
- a3 – cultivar *Lax*,
- a4 – cultivar *Bluecrop*.

The replication plot consists of 10 plants with 3 replications. The experimental layout is arranged in blocks and positioned in rows. Experimental factor B is the type of certified organic fertilizer, which will be tested on blueberry, as follows: b1 = completely natural organic fertilizer at a dose of 150 g/plant – soil application **(**plants 1-10**)**; b2 = fertilization with vegetable amino acids, an organic fertilizer with nitrogen and phosphorus at doses of 0.6 mL/plant (0.2%) + 1.5 mL/plant (0.5%) + 300 g/plant – foliar and soil application **(**plants 11–20); b3 = fertilization with vegetable amino acids and fully natural organic fertilizer at doses of 1.2 mL/plant (0.3%) + 150 g/plant, foliar and soil application (plants 21-30**);** b4 **=** unfertilized control (plants 31-40**).**

Determination of yield: By weighing the total yield/plant (kg/plant).

Determination of average weight: By weighing a sample of 50 fruits for each genotype (15 plants/genotype), the average weight of fruits was determined, and the results were expressed in g/fruit.

Determination of length, diameter, and shape index: The length and diameter of the fruit were determined by measuring this using digital calliper. The length and diameter of the fruit were determined by measuring the fruit using a digital caliper. The shape index (SI) of the fruit was calculated as the ratio of these two dimensions (Tudor et al., 2014; Jamieson, 2016).

Determination of fruit firmness: By measuring each fruit sample with a Bareis HPE II Fff non-destructive testing, with a measuring surface of 0.25 cm^2.

Determination of fruit pH: The pH values were measured in blueberry fresh juice (Song et al., 2018) using a pH meter (ISFET pH Meter, IQ 125, Japan).

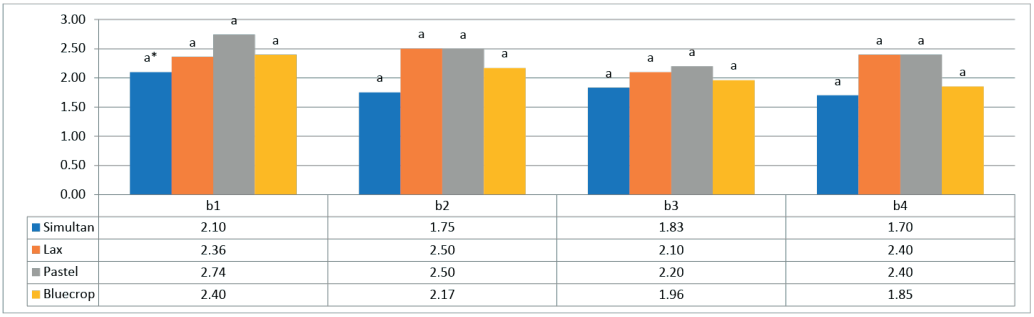
Determination of total titratable acidity: TTA was determined by titrable method (Ermakov et al., 1987). The principle of the method is to neutralize a volume of aqueous fruit extract with a solution of NaOH 0.1N in the presence of phenolphthalein as an indicator.

Determination of Total Soluble Solid Content: Total soluble solids (TSS) were determined using a Kruss DR201-95 refractometer, and the results were reported as Brix at 20 °C.

Statistical Analysis: All analyses were performed in triplicate, and data were reported as mean standard deviation (SD). Microsoft Excel 2021 (XLSTAT) was used for data statistical analysis. One-way analysis of variance (ANOVA) and two-way ANOVA and Duncan's multiple range tests, were performed.

RESULTS AND DISCUSSIONS

The obtained results highlight a positive effect of fertilization on fruit yield (Figure 1) per plant for all four blueberry cultivars compared to the unfertilized control (b4). For the 'Simultan' cultivar, the highest yield was recorded in treatment b3 (2.54 kg/plant), indicating a good response to the combined fertilization with b3. Treatments b1 and b2 showed similar values, both clearly higher than the control (1.95 kg/plant). In the case of 'Lax' cv., fertilization led to a noticeable increase in yield, with the maximum value also observed in b3 (2.82 kg/plant). The differences among fertilized treatments suggest a higher efficiency of combined foliar and soil applications compared to soil-only fertilization. The 'Pastel' cultivar exhibited high yield levels under all fertilized treatments, reaching the highest value in b3 (2.93 kg/plant). Compared with the control (2.16 kg/plant), the yield increase confirms the positive responsiveness of this cultivar to organic fertilizers and biostimulants (Bryla et al., 2015). For 'Bluecrop', which recorded the highest absolute yield values among the studied cultivars, treatments b1 (3.04 kg/plant) produced superior results, demonstrating a high productive potential and good adaptability to different fertilization strategies. Meanwhile, the unfertilized control showed a considerably lower yield (2.25 kg/plant).



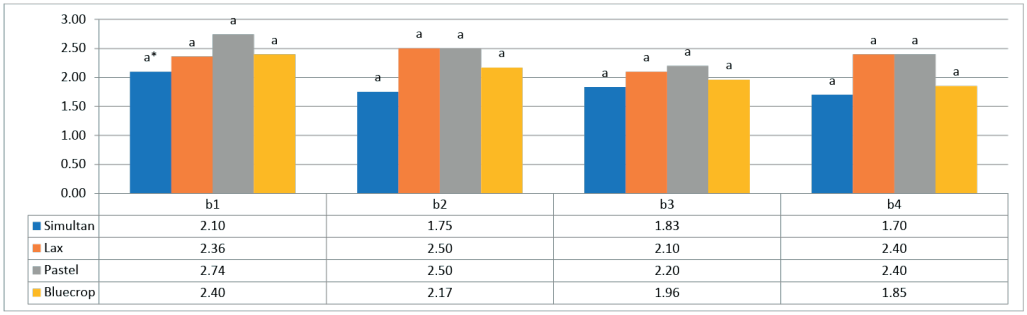
	b1	b2	b3	b4
Simultan	2.10	1.75	1.83	1.70
Lax	2.36	2.50	2.10	2.40
Pastel	2.74	2.50	2.20	2.40
Bluecrop	2.40	2.17	1.96	1.85

Note: *Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$

Figure 1. The influence of fertilizer on the production of blueberry cultivars

The data indicate that fertilization treatments influenced the average fruit weight (Figure 2) in all analyzed blueberry cultivars, although the response varied depending on the cultivar and fertilization strategy (Jiang et al., 2019). For the 'Simultan' cultivar, the highest average fruit weight was recorded in treatment b1 (2.10 g/fruit), while the lowest value occurred in the unfertilized control (b4 - 1.70 g/fruit). Treatments b2 and b3 showed intermediate values, suggesting that the soil application of b1 alone had a more pronounced effect on fruit size for this cultivar.

In the case of 'Lax', the greatest average fruit weight was observed in treatment b2 (2.50 g), followed closely by the unfertilized control (2.40 g). This indicates a favorable response to the combined foliar and soil application of b2, while treatment b3 resulted in comparatively smaller fruits.

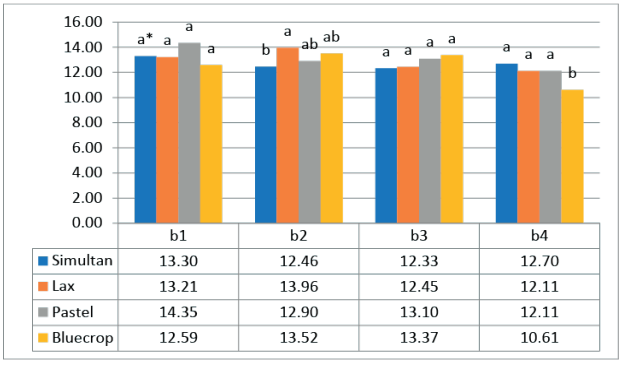


	b1	b2	b3	b4
Simultan	2.10	1.75	1.83	1.70
Lax	2.36	2.50	2.10	2.40
Pastel	2.74	2.50	2.20	2.40
Bluecrop	2.40	2.17	1.96	1.85

Note: *Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

Figure 2. The influence of fertilizer on the berry weight of the blueberry cultivar

The 'Pastel' cultivar exhibited the highest fruit weight across all cultivars, with a maximum value in treatment b1 (2.74 g). All fertilized treatments produced larger fruits than the control, demonstrating the positive effect of fertilization on fruit size for this cultivar. For 'Bluecrop', average fruit weight decreased progressively from b1 (2.40 g) to the unfertilized control (1.85 g). Fertilization treatments, particularly b1, clearly enhanced fruit weight (Figure 2), indicating a strong dependence of this cultivar on an adequate nutrient supply for optimal fruit development. The results show that fertilization treatments affected fruit height in all blueberry cultivars, with distinct responses depending on the cultivar and fertilization scheme applied. For the 'Simultan' cultivar, the highest fruit height was recorded in treatment b1 (13.30 mm), while slightly lower but comparable values were observed in the fertilized treatments b2 and b3. The unfertilized control (b4) showed intermediate values, indicating a moderate response of fruit height to fertilization in this cultivar. In the case of 'Lax', the maximum fruit height was observed in treatment b2 (13.96 mm), followed by b1 (13.21 mm). In the case of 'Lax', the maximum fruit height was observed in treatment b2 (13.96 mm), followed by b1 (13.21 mm). Treatments b3 and the control resulted in smaller fruits, suggesting that the combined foliar and soil application of b2 had a stronger influence on fruit elongation. The 'Pastel' cultivar exhibited the highest fruit height among all cultivars, reaching a maximum value in treatment b1 (14.35 mm). All fertilization treatments resulted in larger fruits compared to the unfertilized control, confirming the positive effect of nutrient application on fruit size for this cultivar (Jayasinghege et al., 2024). For 'Bluecrop', fertilization markedly increased fruit height compared with the control. The highest values were obtained in treatments b2 (13.52 mm) and b3 (13.37 mm), while the unfertilized control showed the lowest value (10.61 mm), indicating a strong dependency of fruit height on fertilization in this cultivar (Figure 3).

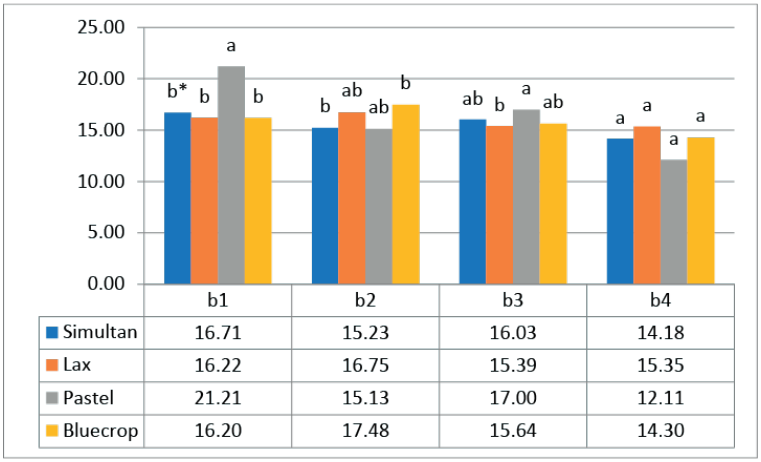


	b1	b2	b3	b4
Simultan	13.30	12.46	12.33	12.70
Lax	13.21	13.96	12.45	12.11
Pastel	14.35	12.90	13.10	12.11
Bluecrop	12.59	13.52	13.37	10.61

Note: *Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

Figure 3. The influence of fertilizer on the berry height of blueberry cultivars

The results indicate that fertilization treatments significantly influenced fruit diameter (Figure 4) across all blueberry cultivars (Coates et al., 2012), with notable differences depending on the cultivar and fertilization strategy (Zhang et al., 2023). For the 'Simultan' cultivar, the largest fruit diameter was recorded in treatment b1 (16.71 mm), followed by b3 (16.03 mm). All fertilized treatments resulted in larger fruit diameters compared to the unfertilized control (14.18 mm), highlighting the positive effect of fertilization on fruit size. In the case of 'Lax', the highest fruit diameter was observed in treatment b2 (16.75 mm), slightly exceeding b1 (16.22 mm). Treatments b3 and the control showed similar and lower values, indicating that the combined foliar and soil application of b2 was most effective in increasing fruit diameter for this cultivar. The 'Pastel' cultivar exhibited the greatest fruit diameter among all cultivars, reaching 21.21 mm in treatment b1, which represents a substantial increase compared with b2 (15.13 mm). Fertilization markedly improved fruit diameter in this cultivar Jeyabaskaran et al. (2021) particularly under soil application of b1 (Mazzoni et al., 2020). For 'Bluecrop', the maximum fruit diameter was recorded in treatment b2 (17.48 mm), followed by b1 (16.20 mm). All fertilized treatments outperformed the control (14.30 mm), confirming the strong response of this cultivar to fertilization in terms of fruit diameter.



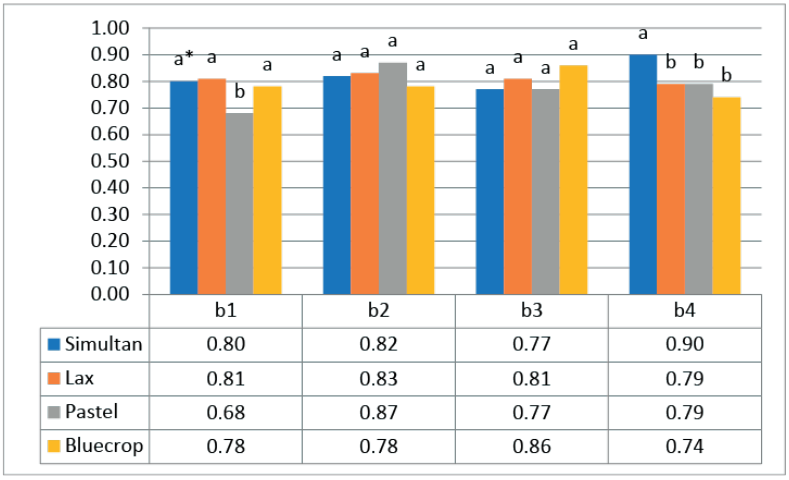
	b1	b2	b3	b4
Simultan	16.71	15.23	16.03	14.18
Lax	16.22	16.75	15.39	15.35
Pastel	21.21	15.13	17.00	12.11
Bluecrop	16.20	17.48	15.64	14.30

Note: *Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

Figure 4. The influence of fertilizer on the berry diameter of blueberry cultivars

The fruit shape index values indicate that fertilization treatments influenced fruit shape, although the magnitude of variation was generally moderate across cultivars (Mota et al., 2022). For the 'Simultan' cultivar, the highest shape index was recorded in the unfertilized control (b4 - 0.90), while fertilized treatments showed slightly lower values, particularly in b3 (0.77). This suggests that fertilization tended to produce more rounded fruits, whereas the control resulted in slightly more elongated fruits. In the case of 'Lax', fruit shape index values were relatively uniform across treatments, ranging from 0.79 to 0.83, indicating a stable fruit shape that was only marginally affected by fertilization strategy. The 'Pastel' cultivar exhibited greater variability in fruit shape index (Figure 5), with the highest value observed in b2 (0.87). This result suggests that the combined foliar and soil application of b2 influenced fruit elongation, while the lowest value was recorded in b1 (0.68). For 'Bluecrop', the maximum fruit shape index was obtained in treatment b3 (0.86), while the lowest value occurred in the unfertilized control (0.74). These findings indicate that fertilization, particularly treatment b3, contributed to a more elongated fruit shape in this cultivar. The results demonstrate that fertilization treatments had a pronounced effect on fruit firmness in all analyzed blueberry cultivars, with clear differences among treatments. For the 'Simultan' cultivar, fruit firmness was highest in treatment b1 (25.87 N) and decreased progressively

through b2 and b3, reaching the lowest value in the unfertilized control (13.05 N). These results indicate that fertilization, particularly soil application of b1, significantly enhanced fruit firmness. In the case of 'Lax', the highest firmness was observed in treatment b2 (20.52 N), followed by b1 (18.70 N) and b3 (17.53 N). The unfertilized control again showed the lowest firmness (14.22 N), suggesting a positive effect of combined foliar and soil fertilization on fruit texture.

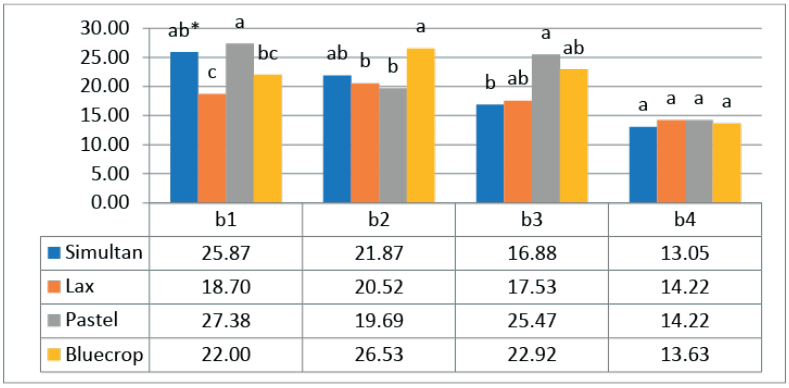


	b1	b2	b3	b4
Simultan	0.80	0.82	0.77	0.90
Lax	0.81	0.83	0.81	0.79
Pastel	0.68	0.87	0.77	0.79
Bluecrop	0.78	0.78	0.86	0.74

Note: *Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

Figure 5. The influence of fertilizer on the berry shape index of blueberry cultivars

The 'Pastel' cultivar exhibited the highest firmness values overall, with maximum firmness recorded in b1 (27.38 N) and b3 (25.47 N). In contrast, the control treatment resulted in markedly lower firmness (14.22 N), emphasizing the strong influence of fertilization on fruit structural integrity in this cultivar. For 'Blueray', the greatest fruit firmness was achieved in treatment b2 (26.53 N), followed by b3 (22.92 N) and b1 (22.00 N). The unfertilized control displayed the lowest firmness (13.63 N), highlighting the importance of fertilization for maintaining fruit firmness in this cultivar (Figure 6).

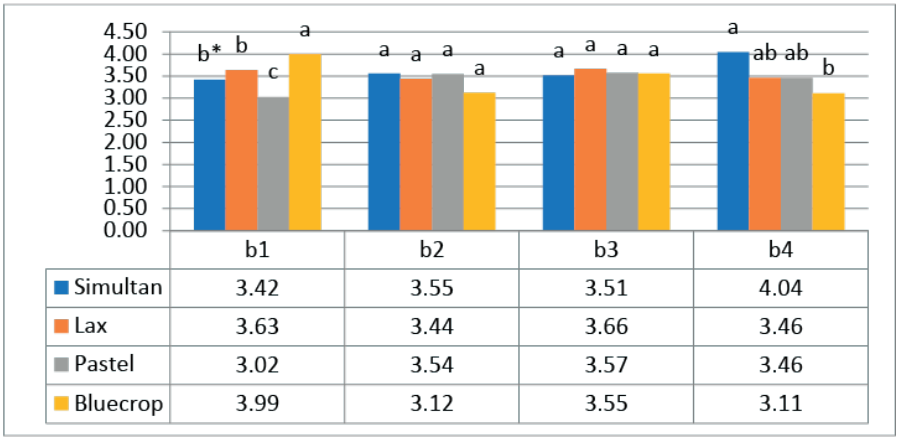


	b1	b2	b3	b4
Simultan	25.87	21.87	16.88	13.05
Lax	18.70	20.52	17.53	14.22
Pastel	27.38	19.69	25.47	14.22
Bluecrop	22.00	26.53	22.92	13.63

Note: *Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

Figure 6. The influence of fertilizer on the berry firmness of blueberry cultivars

The results show variable effects of fertilization on the pH of the cellular juice across different blueberry cultivars (Figure 7). For the 'Simultan' cultivar, the highest pH of the cellular juice was recorded in the unfertilized control (4.04), while fertilized treatments showed slightly lower values, ranging between 3.42 and 3.55. This suggests that fertilization may contribute to a modest acidification of fruit juice in this cultivar. In the case of 'Lax', the pH of the cellular juice values was relatively stable across treatments, ranging from 3.44 to 3.66, with no clear trend associated with fertilization, indicating a cultivar-specific pH regulation. The 'Pastel' cultivar exhibited slightly higher pH values in fertilized treatments (3.54 to 3.57) compared to the control (3.46), which may suggest a mild alkalinizing effect of fertilization on fruit juice in this cultivar. For the 'Bluecrop' cultivar, the lowest pH was observed in the unfertilized control (3.11), with fertilized treatments showing increased pH values, particularly treatment b1 (3.99). This indicates that fertilization, especially the soil application of b1, can raise the cellular juice pH in this cultivar.

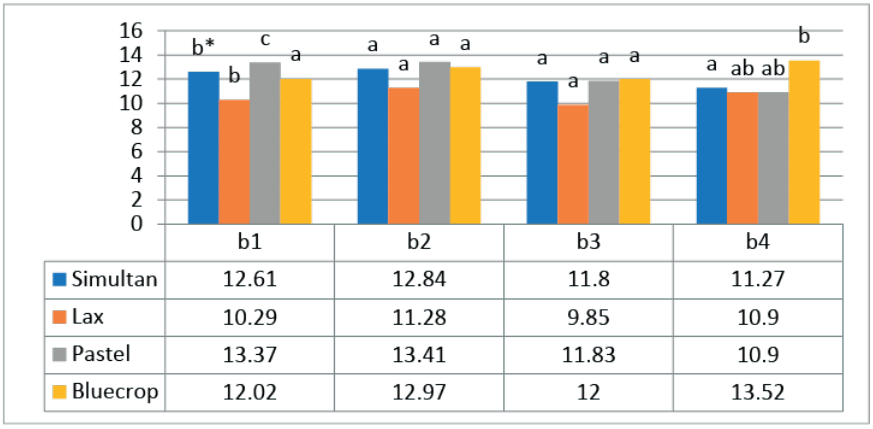


	b1	b2	b3	b4
Simultan	3.42	3.55	3.51	4.04
Lax	3.63	3.44	3.66	3.46
Pastel	3.02	3.54	3.57	3.46
Bluecrop	3.99	3.12	3.55	3.11

Note: *Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

Figure 7. The influence of fertilizer on the berry pH of blueberry cultivars

The data indicate that fertilization treatments influenced the soluble solids content (SSC) of blueberry fruits, although the response varied among cultivars (Figure 8). For the 'Simultan' cultivar, the highest SSC was recorded in treatment b2 (12.84°Brix), followed closely by b1 (12.61°Brix). The lowest value was observed in the unfertilized control (11.27 °Brix), suggesting that fertilization contributed to higher sugar accumulation in the fruits. In the case of 'Lax', SSC values were moderately influenced by fertilization. The highest content was observed in b2 (11.28%), while treatment b3 resulted in the lowest SSC (9.85°Brix). The control showed intermediate values (10.90°Brix), indicating a cultivar-specific response. The 'Pastel' cultivar exhibited the highest SSC among fertilized treatments, with maximum values in b2 (13.41°Brix) and b1 (13.37°Brix), while the control showed lower content (10.90°Brix). These results demonstrate the positive effect of fertilization, particularly b1, on fruit sugar accumulation. For 'Bluecrop', the highest SSC was recorded in the unfertilized control (13.52°Brix), while fertilized treatments ranged between 12.00°Brix and 12.97°Brix. This suggests that fertilization had a minor effect on sugar content for this cultivar, possibly due to intrinsic genetic factors (Koort, 2023).

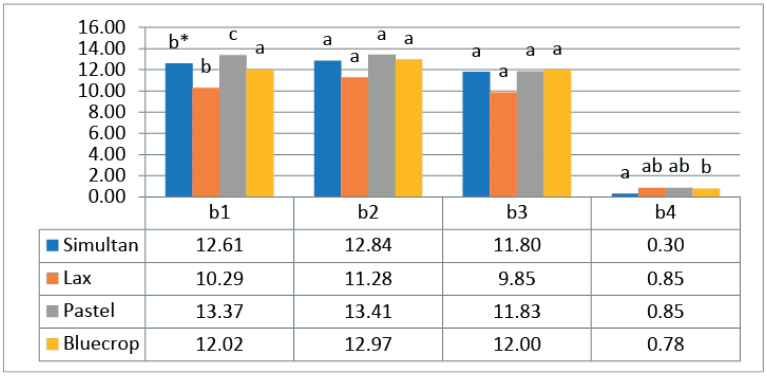


	b1	b2	b3	b4
Simultan	12.61	12.84	11.8	11.27
Lax	10.29	11.28	9.85	10.9
Pastel	13.37	13.41	11.83	10.9
Bluecrop	12.02	12.97	12	13.52

Note: *Different letters between cultivars denote significant differences (Duncan test. $p < 0.05$)

Figure 8. The influence of fertilizer on the berry total soluble solids content of blueberry cultivars

The results show that fertilization treatments had a substantial effect on fruit acidity across all blueberry cultivars. For the 'Simultan' cultivar, the highest acidity was recorded in fertilized treatments b1 (12.61%) and b2 (12.84%), while the unfertilized control showed an extremely low acidity (0.30%), suggesting that fertilization is critical for maintaining normal organic acid levels in fruits. In the case of 'Lax', fruit acidity followed a similar trend, with the highest values observed in b2 (11.28%) and b1 (10.29%), while the control (Figure 9) had very low acidity (0.85%). Fertilization clearly supports the accumulation of organic acids in this cultivar. The 'Pastel' cultivar also exhibited the highest acidity in fertilized treatments (b2 - 13.41%, b1 - 13.37%), whereas the control showed a significant decrease (0.85%), indicating a strong influence of nutrient management on fruit acidity. For 'Bluecrop', fertilized treatments produced higher acidity levels (b2 - 12.97%, b1 - 12.02%) compared with the control (0.78%), highlighting the critical role of fertilization in maintaining optimal acid content for fruit quality.



	b1	b2	b3	b4
Simultan	12.61	12.84	11.80	0.30
Lax	10.29	11.28	9.85	0.85
Pastel	13.37	13.41	11.83	0.85
Bluecrop	12.02	12.97	12.00	0.78

Note: *Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

Figure 9. The influence of fertilizer on the berry total acidity content of blueberry cultivars

CONCLUSIONS

The results of this study demonstrate that fertilizer type has a significant influence on vegetative growth yield and fruit quality of highbush blueberry (*Vaccinium corymbosum* L.), with cultivar-specific responses. The application of organic fertilizers and biostimulants signifi-

cantly increased yield per plant in all studied cultivars compared with the unfertilized control. Fertilization positively affected fruit size parameters, including average fruit weight, height, and diameter. In most cases, the highest values were obtained under treatments involving soil-applied organic fertilizers. The 'Pastel' cultivar consistently produced the largest fruits across treatments, indicating strong genetic stability for fruit size. Fruit firmness was significantly improved by fertilization in all cultivars, which is an important quality attribute for storage, transport, and marketability. In general, fertilized treatments contributed to a more balanced sugar–acid profile, although the magnitude and direction of the response varied among cultivars. While 'Simultan' and 'Pastel' showed increased soluble solids and acidity following fertilization, 'Bluecrop' exhibited smaller changes, suggesting stronger genetic control over these traits. Overall, the use of organic fertilizers and biostimulants represents an effective strategy for improving yield and fruit quality of highbush blueberry under Romanian pedoclimatic conditions. Fertilization programs should be tailored to individual cultivars in order to maximize their biological and productive potential.

ACKNOWLEDGEMENTS

This research was carried out with the support of Ministry of Agriculture and Rural Development and it was financed from Project ADER 23.1.1./18.07.2023.

REFERENCES

Almohammedi, O., Sekhi, Y., & Ismail, M. (2023). A Review of Nano fertilization and its role on growth, yield and quality characteristics of fruit trees. *Tikrit Journal for Agricultural Sciences*, *23*(1), 158-167.

Banados, M. P., Strik, B. C., Bryla, D. R., & Righetti, T. L. (2012). Response of highbush blueberry to nitrogen fertilizer during field establishment, I: Accumulation and allocation of fertilizer nitrogen and biomass. *HortScience*, *47*(5), 648-655.

Bryla, D. R., & Strik, B. C. (2015). Nutrient requirements, leaf tissue standards, and new options for fertigation of northern highbush blueberry. *HortTechnology*, *25*(4), 464-470.

Chen, Y. O. N. A., Clapp, C. E., & Magen, H. (2004). Mechanisms of plant growth stimulation by humic substances: The role of organo-iron complexes. *Soil Science and Plant Nutrition*, *50*(7), 1089-1095.

Coates, R. W., Sahoo, P. K., Schwankl, L. J., & Delwiche, M. J. (2012). Fertigation techniques for use with multiple hydrozones in simultaneous operation. *Precision Agriculture*, *13*(2), 219-235.

Ehret, D. L., Brenda F., Tom F., Tom H., and David R. B. (2012). Effects of drip irrigation configuration and rate on yield and fruit quality of young highbush blueberry plants. *HortScience, 47*(3), 414-421.

Ermakov, A. I., Arasimovich, V. V., & Yarosh, N. P. (1987). Methods of biochemical research of plants. *Leningrad: Agropromizdat*, 429c.

Godoy, C., Monterubbianesi, G., & Tognetti, J. (2008). Analysis of highbush blueberry (*Vaccinium corymbosum* L.) fruit growth with exponential mixed models. *Scientia Horticulturae*, *115*(4), 368-376.

Hanson, E.J. & Hancock, J.B. (1996) Managing the nutrition of highbush blueberries. *Michigan State Univ. Ext. Bul. Publ*. E-2011 10.1097/00010694-198901000-00008

Hart, J., Strik, B., White, L. & Yang, W. (2006) Nutrient management for blueberries in Oregon. *Oregon State Univ. Ext. Serv. Publ. EM* 8918 10.1016/B978-0-12-800138-7.00002-4

Jamieson, A. R. (2016, August). Strawberry shape: phenotypic variation in length and width. In *VIII International Strawberry Symposiu*m, *1156*, 135 140.

Jayasinghege, C. P., Bineng, C., & Messiga, A. J. (2024). Effects of long-term nitrogen fertilization and application methods on fruit yield, plant nutrition, and soil chemical properties in highbush blueberries. *Horticulturae*, *10*(11), 1205.

Jeyabaskaran, K. J., Shirgure, P. S., Pandey, V., Srivastava, A. K., & Uma, S. (2021). Fertigation in horticulture: a guarantee to economized quality production. *Indian J. Fertil*, *17*, 364-383.

Jiang, Y., Zeng, Q., Wei, J., Jiang, J., Li, Y., Chen, J., & Yu, H. (2019). Growth, fruit yield, photosynthetic characteristics, and leaf microelement concentration of two blueberry cultivars under different long-term soil pH treatments. *Agronomy*, *9*(7), 357.

Koort, A. (2023). The effect of fertilizing and modified atmosphere storage on blueberry (*Vaccinium* spp.) fruit quality. Doctoral Theses of the Estonian University of Life Sciences

Korcak, R. F. (1988). Nutrition of blueberry and other calcifuges *Horticultural Reviews, 10*(183-227).

Larco, Handell O. (2010). Effect of planting method, weed management, and fertilizer on plant growth and yield of newly established organic highbush blueberries. *Doctoral dissertation*, Department of Horticulture, Oregon State University.

Mazzoni, L., Balducci, F., Di Vittori, L., Scalzo, J., Capocasa, F., Zhong, C. F., ... & Mezzetti, B. (2020). Yield and nutritional quality of highbush blueberry genotypes trialled in a Mediterranean hot summer climate. *Journal of the Science of Food and Agriculture*, *100*(9), 3675-3686.

Merhaut, D. J., and Darnell R. L. (1995). Ammonium and nitrate accumulation in containerized southern high-bush blueberry plants. *HortScience*, *30*(7), 1378-1381.

Mota, M., Martins, M. J., Policarpo, G., Sprey, L., Pastaneira, M., Almeida, P., ... & Oliveira, C. M. (2022). Nutrient content with different fertilizer

management and influence on yield and fruit quality in apple cv. Gala. *Horticulturae*, *8*(8), 713.

Peterson, L. A., E. J. Stang, and M. N. Dana. (1988). Blueberry Response to NH4-N and NO3-N. *Journal of the American society for horticultural science, 113*(1), 9-12.

Roussos, P. A., Triantafillidis, A., Kepolas, E., Peppas, P., Piou, A., Zoti, M., & Gasparatos, D. (2022). Effects of integrated and organic management on strawberry (cv. Camarosa) plant growth, nutrition, fruit yield, quality, nutraceutical characteristics, and soil fertility status. *Horticulturae*, *8*(2), 184.

Song, H. N., Ji, S. A., Park, H. R., Kim, H. H., & Hogstrand, C. (2018). Impact of various factors on color stability of fresh blueberry juice during storage. *Preventive nutrition and food science*, *23*(1), 46.

Tudor, V., Asănică, A., & Neagu, T. (2014). First results of some day-neutral strawberry cultivars behavior in the Bucharest area conditions. *Uni. Agron. Sci. and Veterinary Medicine of Bucharest*, *58*, 101-106.

Vargas, O. L., & Bryla, D. R. (2015). Growth and fruit production of highbush blueberry fertilized with ammonium sulfate and urea applied by fertigation or as granular fertilizer. *HortScience*, *50*(3), 479-485.

Zhang, X., Li, S., An, X., Song, Z., Zhu, Y., Tan, Y., ... & Wang, D. (2023). Effects of nitrogen, phosphorus and potassium formula fertilization on the yield and berry quality of blueberry. *PLoS One*, *18*(3), e0283137.