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Rooting of semi-hardwood blueberry mini-cuttings from different cultivars from the highbush and rabbiteye groups

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Abstract. The objective of this work was to evaluate the rooting of semi-hardwood blueberry minicuttings, from different cultivars and groups, from the Highbush and Rabbiteye groups in the same culture medium. The experiment was carried out in an agricultural greenhouse in a commercial nursery whith semi-hardwood mini-cuttings were used. The work was conducted, with cuttings segmented into mini-cuttings with three gems and an average diameter of 1.5 mm. Subsequently, their bases were immersed, for 10 seconds, in a commercial solution of IBA, in the concentration of 2.000 mg.L^{-1}, with a mixture of coarse-grained sand and commercial substrate in the proportion of 1:1 as a substrate. The Bifactorial experimental design used was in completely randomized blocks, with two groups (highbush and rabbiteye) and six cultivars (Georgiagem, Misty, O'Neal, Bluegem, Powderblue and Woodard), with four replications and ten cuttings per plot. The percentage of rooted cuttings and surviving cuttings, average number of roots and shoots per cuttings, length of the largest root and shoot, were evaluated. It was found that, in general, the rabbiteye group was superior when compared to the highbush group. Blueberry cultivars from the rabbiteye group when propagated by semi-hardwood cuttings, have greater rooting facility than cultivars from the highbush group. The rooting potential between the cultivars in blueberry studied was different, allow the formation of 95% of cuttings rooted in 90 days.
Keyword: Nursery, Plant propagation, Small fruits, *Vaccinium* spp.

Introduction

The blueberry is a fruit species of temperate climate originating in Europe and North America, its fruits have been consumed internationally, significantly increasing the world cultivation (Wang et al., 2015). In Brazil, the crop is expanding, but among the main obstacles to its national dissemination, there is a lack of technical knowledge and the low production of seedlings limited by the difficulty of propagation in most cultivars (Koyama et al., 2019; Shahab et al., 2018).

The limitation in the production of seedlings ends up making the value of the seedling very high and thus, ceasing to be attractive to the farmer who does not yet have the domain of technical knowledge and / or success in cultivating this species. The blueberry can be propagated sexually through seeds and asexual based on the use of vegetative structures. In seed propagation, according to Fischer et al. (2010) the percentage of germination can reach approximately 75%, however this method presents the genetic segregation of new plants as an inconvenience.

In a study carried out to verify the rooting capacity of woody cuttings of highbush blueberry group (*Vaccinium corymbosum* L.) using different concentrations of indole-butyric acid, An et al., (2019) found better responses of the concentrations, than exogenous concentrations of IBA with 1000 or 2000 ppm IBA induced root formation and increased the number of roots in most blueberry cultivars.

The blueberry, when propagated by cuttings, whether woody or herbaceous, makes it possible to obtain, depending on the cultivar, a rooting in the order of 60% to 80%. In Europe, both methods of propagation are used, while in the United States, it is preferred to use woody cuttings for the highbush group and herbaceous cuttings for the rabbiteye group (Bounous, 2003). Another important factor to be considered in the successful rooting of blueberry cuttings is the time taken to remove the cuttings, which is of fundamental importance, since in different periods of time the presence of various hormonal substances also changes, as well as the nutritional substances that favor rooting (Braha & Rama, 2016).

The rooting of cuttings is determined by a complex interaction between internal and environmental factors and the feasibility of using the technique for cutting depends on the ability to form adventitious roots of each species and / or cultivar or even on the propagation technique (Li et al., 2009). Rooting skills of woody cuttings vary significantly between different blueberry cultivars, when working with different Bluebeauty and Biloxi cultivars expressed higher rooting percentage (68.55% and 68.01%, respectively) and comprehensive rooting index values (35.18% and 33.59%, respectively) (An et al., 2019).

Auxins can also act on root development, because in addition to determining almost all aspects of rejuvenation of plants, in the roots, the phenotypes associated with auxin are characterized by an increase dependent on the concentration in the length of the root hairs and the primary root (Peret et al., 2009). For Shahzad et al., (2019), the propagation of guava through cuttings can yield the best results with the application of 1600 ppm of IBA followed by 7000 ppm of ANA in peat + soil and soil + peat + sand + bagasse, respectively. The application of ANA has a positive effect on the rooting of guava.

Braha & Rama (2016), when conducting studies with the propagation of blueberry, found that the rooting capacity between herbaceous cuttings increases from the base to the apex of the branch, obtaining better results when using the middle portion of it, considering that this part is richer in nutrients and rhizogenic matter that enhance the induction of adventitious roots.

For the propagation of plants, there are some methods to propagate vegetatively, among the methods of vegetative propagation, mini-cuttings can be used as an alternative and successfully on a commercial scale in different species, and can be presented as a good alternative for blueberry cultivation, in addition to making it possible to obtain a larger number of plants from a single matrix plant. Jung et al. (2008), when studying the percentage of rooting, survival, length and diameter of herbaceous cuttings from different blueberry cultivars in the Highbush group, found the influence of the cultivar on rooting and the size of cuttings in field survival, where mini-cuttings (8 -12 cm) showed greater survival with 66.7% compared to 49.3%, of the larger cuttings (14 -16 cm).

In view of the above, this study aimed to evaluate the rooting of semi-hardwood blueberry mini-cuttings, from different cultivars of the groups Highbush and Rabbiteye in the same cultivation medium.

Material and methods

The experiment was carried out in an agricultural greenhouse in a commercial nursery, located in the city of Pelotas - RS. In this work, semi-hardwood mini-cuttings were used, from the highbush group (Georgiagem, Mysty and O'Neal) and from the rabbiteye group (Bluegem, Powderblue and Woodard), from secondary branches from two-year-old matrix plants, grown in cartons of cultivation of polyethylene with dimensions of 17 x 23 cm containing commercial peat-type substrate, fertigated according to the recommendation for culture with the water pH being corrected to 5.0 with Quimifol P30®.

The branches were collected and the experiment was conducted in the summer period, beginning of the second half of February and stored in buckets of water. Subsequently, they were segmented in mini-cuttings with three gems and an average diameter of 1.5 mm, discarding the apical part of them. After segmentation, the leaves at the base of the cuttings were removed, leaving only a whole leaf at the upper end.

With the aid of a pocket knife, two superficial lesions were made at the base of the mini-cuttings on the opposite side of the gem, taking care to maintain its integrity. Subsequently, their bases were immersed, for 10 seconds, in a commercial solution of IBA (Clone Gel®), in the concentration of 2.000 $mg.L^{-1}$, and placed to root on wooden benches of 2.45 x 1.23 m, 20 cm high, containing a layer of crushed stone No. 2 under a 2 mm plastic screen at the bottom, to facilitate drainage, and a mixture of coarse-grained sand and commercial substrate Turfa Fértil® in the proportion of 1: 1 as a substrate.

After planting, the cuttings were sprayed with Orthocid® 500 PM (2.5 $g.L^{-1}$ of water), the same operation being repeated after seven days. The propagating material was kept in a protected environment, under an automatic intermittent irrigation system by micro sprinkler regulated according to the climate, in order to keep the leaves of the cuttings covered by a thin layer of water. The pH of the water used for irrigation was corrected to approximately 5.0 with Quimifol P 30® 5.0, as recommended by Freire (2004) and Campos et al. (2005).

The Bifactorial experimental design used was in completely randomized blocks, with two groups (highbush and rabbiteye) and six cultivars (Georgiagem, Misty, O'Neal, Bluegem, Powderblue and Woodard), with four replications and ten cuttings per plot.

At 90 days, the percentage of rooted cuttings and surviving cuttings (without rooting), average number of roots per cuttings, length of the largest root, average number of shoots and the length of the largest shoot were evaluated.

The data were submitted to analysis of variance by the F test and, when significant, were compared to the means by the Duncan test at 5% probability. The data expressed as a percentage (rooting and surviving cuttings) were transformed trough the arcsin function $(x / 100)^{1/2}$. The statistical program WinStat, version 2.0 (Machado & Conceição, 2005) was used for the analyzes.

Results and discussion

According to the results obtained, it was found that, in general, the rabbiteye group was superior when compared to the highbush group.

For the rooting percentage, when comparing the different cultivars, Bluegem (95%) and Woodard (95%), both from the rabbiteye group, were superior in relation to the cvs. Georgiagem and O'Neal, from the highbush group, which had the lowest rooting percentages (30% and 48%, respectively), similar results were found for the variable percentage of cuttings survival (Figure 1).

The rooting percentage obtained in the cultivars Bluegem (95%) and Woodard (95%) is compatible with the work carried out by Fischer et al., (2013) with cultivars from the same blueberry group, where they obtained similar results in mini-cuttings with only one leaf, for the cultivar 'Powderblue', using 2.000 mg.L^{-1} of IBA, reaching a result of 96% to 98% of rooting after 90 days.

For Shahab et al (2018), in rooting work with the cultivar Woodard, with 5cm mini-cuttings, the result regarding the rooting percentage is even more effective when the mini-cuttings are submitted to 3.000 mg.L^{-1} of IBA, obtaining percentages up to 53%.

Litwińczuk & Prokop (2010), when conducting studies with cutting plants from the Highbush group, found that cv. Herbert also showed high rooting percentages, similar to that found in this work, reaching 96% with the use of 2,3: 4,6-Di-O-isopropylidene-2-keto-L-gulonic acid (dikegulac®), applied in cover in the mother plant and the micropiles treated with 3.000 mg.L^{-1} of IBA.

Regarding the different groups, the rabbiteye group was superior in terms of rooting percentage (91%), average number of roots per cuttings (10.42) and percentage of surviving cuttings (0.94%), in relation to the highbush group that showed 50% rooting, 2.95 roots per cuttings and 0.78% of surviving cuttings (Figure 1).

Various factors such as temperature, humidity, luminosity, substrate, period of collection, nutrition, maturation, physiological and environmental conditions of the matrix plant can influence the rooting of mini-cuttings (Jesus et al., 2020).

The superiority found is possibly related to the physiological conditions of the cultivars and the collection period of the mini-cuttings, factor identified by Marangon & Biasi (2013) in which the cultivars Bluegem and Powderblue are influenced in relation to the collection period, with the summer being the most appropriate period.

For Miller et al., (2006) the rooting of blueberry plants in the highbush and rabbitteye groups is variable and can change from one year to the next, reaching percentages between 30 to 80%. The results obtained in this work are compatible with the variables found by (Miller et al., 2006) regarding the minority margin, however reaching rates above 80% in the case of cultivars Bluegem (95%) and Woodard (95%).

Regarding the number of roots per cuttings, it was observed among cultivars that cv. Powderblue had the highest average number (14.05), followed by cvs. Bluegem and Woodard, all from the rabbiteye group, while cv. Georgiagem had the lowest average number (1.18), not only differing from cv. O'Neal, which was also similar to cv. Misty. For the different groups, there was a superiority of the rabbiteye group with an average of 10.42 roots per cuttings, in relation to the highbush group that presented an average of 2.95 (Figure 2).

The results obtained in particular for the Powderblue cultivar are superior to the work carried out by Colombo et al., (2018) which obtained a variable of 3.5 to 5 roots per mini-cuttings to cultivate Powderblue, when cultivated on different substrates (rice husks carbonized, pine bark and vermiculite) submitted to 3.000 mg.L^{-1} of IBA. This difference is probably due to the relationship between the different dosages of IBA or the physical characteristics of the substrate used, which emphasizes the importance of the material to be used.

The results obtained regarding the number of roots per cutting are higher than the number of roots found by Marangon & Biasi (2013), referring to the cultivars Bluegem (5.6) and Powderblue (7.5), when evaluated in similar periods and characteristics.

Regarding the average length of the roots, a behavior similar to the average number of roots was found, however, cv. Bluegem was superior with an average of 8.74 cm, not differing from the other cultivars of the same rabbiteye group. The shortest root length was verified with cv. Georgiagem (2.31 cm). When comparing the different groups, there were no differences between them with respect to this variable (Figure 2).

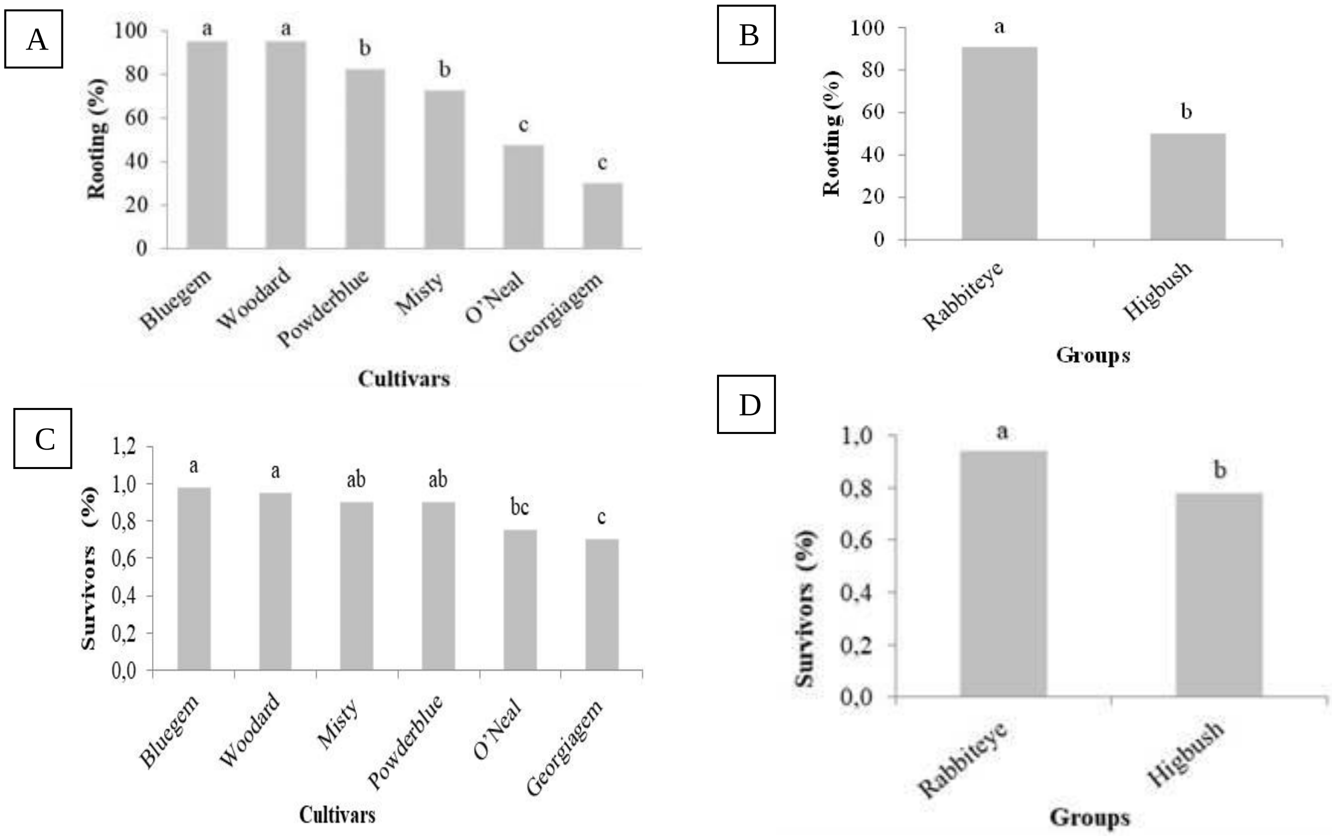

Figure 1. Percentage of rooting and surviving cuttings in, A and C) different cultivars, and B and D) different blueberry groups. Pelotas, 2021.

* Different letters between the columns, differ significantly by the Duncan test at 5% probability.

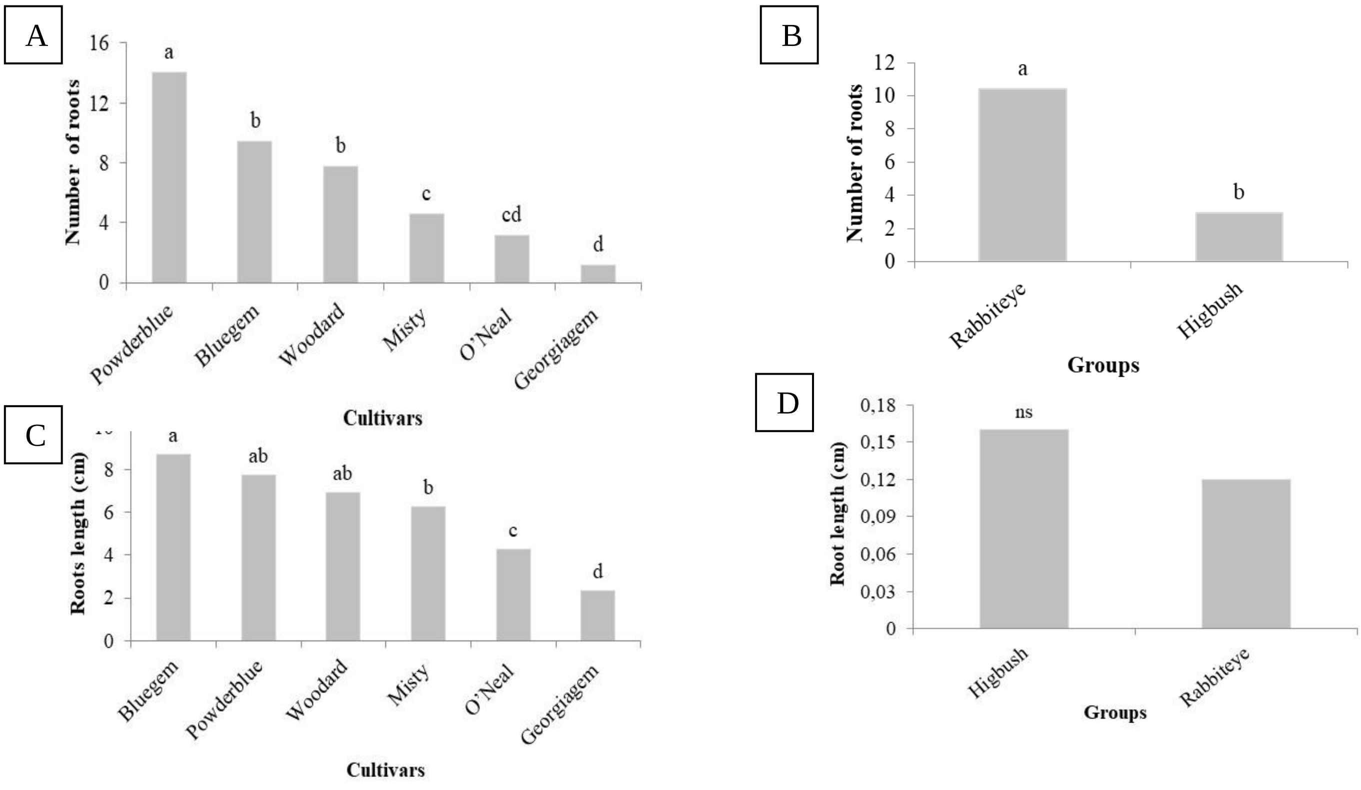

Figure 2. Number and length of root per cuttings in, A and C) different cultivars, and B and D) different groups of blueberry. Pelotas, 2021.

* Different letters between the columns, differ significantly by the Duncan test at 5% probability. [ns] not significant.

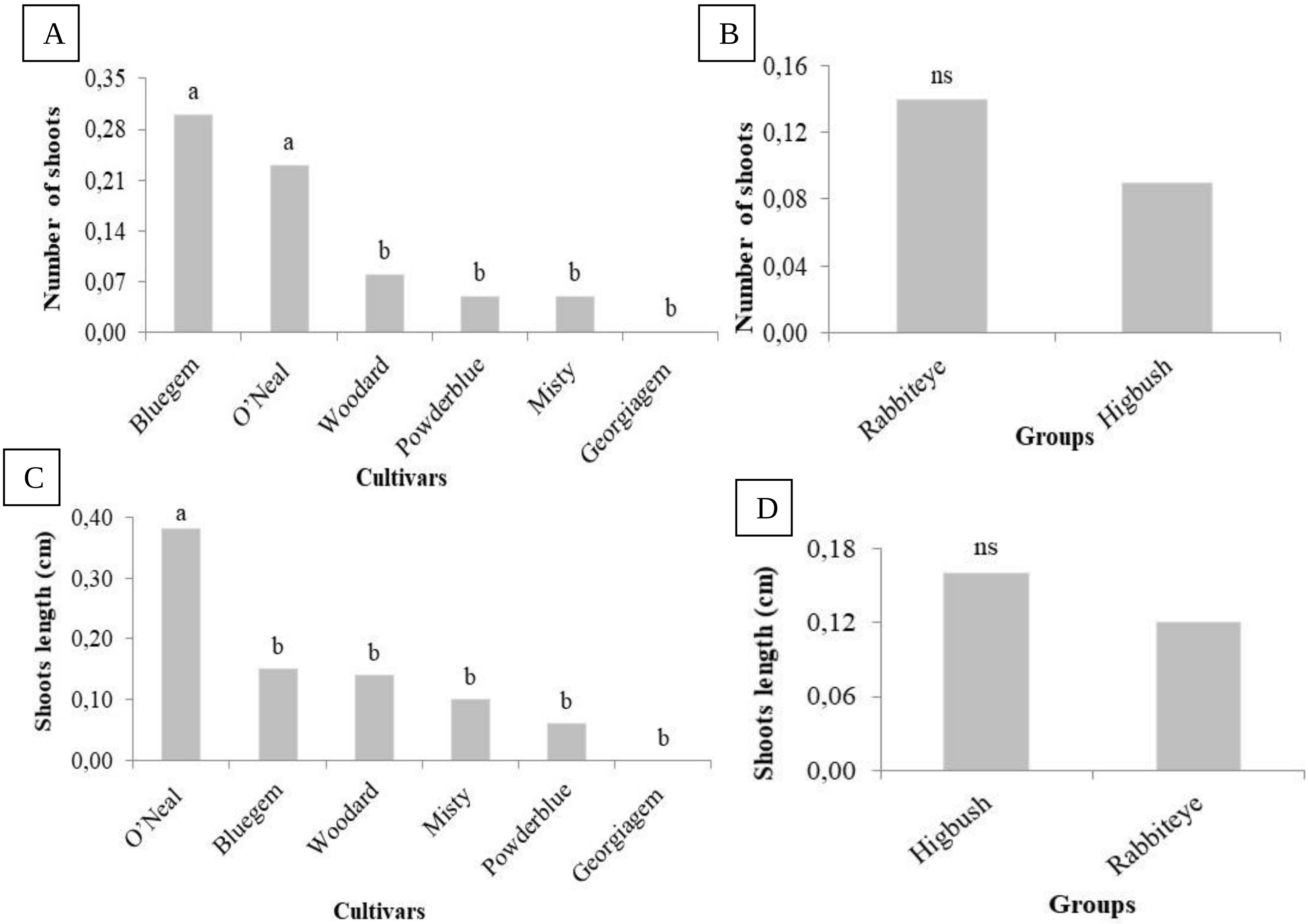

Figure 3. Number and length of shoots per cuttings in A and C) different cultivars and B and D) different groups of blueberry. Pelotas, 2021.

*Different letters between the columns, differ significantly by the Duncan test at 5% probability. ^{ns} not significant.

Koyama et al., (2019) in a work carried out to verify the rooting of blueberry cv, 'Briteblue' with cuttings collected in the summer, in different lengths of cuttings and different substrates using carbonized rice husk and coconut fiber, found similar values of root length, when comparing the different lengths of cuttings (8.10 cm), however when comparing the different substrates, they found higher values with the use of carbonized rice husks (12.7 cm) and much lower when using coconut fiber (3.4 cm).

The good development of the root system is important to reduce the mortality of seedlings in the field after transplantation (Colombo et al., 2018).

For the variables, average number of shoots and longer shoot length per cuttings, cvs. Bluegem and O'Neal presented the highest number of shoots with 0.30 and 0.23 respectively. And the cv. O'Neal showed the longest shoots length with 0.38 cm. Among the different groups, there were no significant differences for this variable.

Root growth points are sources of growth regulators, mainly cytokinins, which are transferred to growth points in the area and thus acting on cell multiplication (Taiz & Zeiger, 2006). This fact may explain the relationship between good root development and the number of shoots per cuttings in the Bluegem cultivar evaluated in this work. On the other hand, this information differs totally when compared to cultivar O'Neal which presented only 48% of rooted cuttings, low amount of root per cuttings and small roots, however presents a high number of shoots per cuttings and the longest shoot length in relation to the other evaluated cultivars.

Conclusions

Under the conditions in which the experiment was conducted, it was concluded that:

- Blueberry cultivars from the Rabbiteye group when propagated by semi-hardwood mini-cuttings, have greater rooting facility than cultivars from the Highbush group.
- The rooting potential among the cultivars Georgiagem, Misty, O'Neal, Bluegem, Powderblue and Blueberry Woodard studied is different.
- The Bluegem and Woodard varieties, when propagated via mini-cutting and subjected to 2.000 mg.L^{-1} IBA, allow the formation of 95% of cuttings rooted in 90 days.

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Author contributions

For the development of this article, the authors actively participated in the installation, conduct and discussion of the data.

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