Yield and fruit quality of the blueberry cultivars Biloxi and Sharpblue in Guasca, Colombia

Rendimiento y calidad de frutos de los cultivares de arándano Biloxi y Sharpblue en Guasca, Colombia

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ABSTRACT

This study aimed to compare the crop yield and some quality-related aspects of the blueberry cultivars Biloxi and Sharpblue in a commercial crop located in Guasca (Colombia). This research was conducted between June and December of 2014, observing two lots with different plant ages at the start of the study: 20 months and 36 months. For 28 weeks, mature fruits were manually harvested and the accumulated yield per plant, the number of fruits, the diameter, the firmness and the total soluble solids (TSS) were determined. The yield of both cultivars was similar in the 20-month-old plants. The 'Sharpblue' 36-month-old plants had an accumulated yield that was 60% higher than that of the 'Biloxi' cultivar due to the fact that they produced a higher number of fruits. In addition, the Sharpblue fruits tended to present higher TSS values. Although both cultivars were similar in terms of firmness, 'Biloxi' stood out more than 'Sharpblue' in the 20-month-old plants. The individual weight and diameter of the fruits were similar for both cultivars.

Key words: *Vaccinium corymbosum* × *Vaccinium darrowii*, highbush blueberries, harvest, crop performance, cultivar selection, soft fruits.

RESUMEN

El objetivo de este estudio fue comparar el rendimiento del cultivo y algunos aspectos relacionados con la calidad de los frutos de arándano de los cultivares Biloxi y Sharpblue, en un cultivo comercial ubicado en Guasca (Colombia). La investigación se desarrolló entre los meses de junio y diciembre de 2014, mediante el seguimiento de dos lotes diferenciados por la edad de las plantas al momento de iniciar el estudio: 20 y 36 meses. Por un periodo de 28 semanas se cosecharon de forma manual los frutos maduros y se determinó el rendimiento acumulado por planta, el peso individual del fruto, el número de frutos, el diámetro, la firmeza y los sólidos solubles totales (SST). El rendimiento de ambos cultivares fue similar en plantas de 20 meses de edad. Las plantas de 36 meses de edad de 'Sharpblue' presentaron un rendimiento acumulado superior en un 60% frente a 'Biloxi', debido a que produjeron un mayor número de frutos. Los frutos de Sharpblue tendieron a presentaron mayores valores de SST. En cuanto a la firmeza, aunque ambos cultivares tuvieron un comportamiento similar, 'Biloxi' se destacó sobre 'Sharpblue' en las plantas de 20 meses de edad. El peso individual y el diámetro de fruto fueron similares para los dos cultivares.

Palabras clave: *Vaccinium corymbosum* × *Vaccinium darrowii*, arándanos altos, cosecha, desempeño de cultivos, selección de cultivares, frutas de baya.

Introduction

The blueberry belongs to the Ericaceae family, *Vaccinium* genus, with approximately 450 species worldwide, mainly distributed in the Northern Hemisphere (Retamales and Hancock, 2012). It belongs to the soft fruit group with spherical berries that are dark blue when ripe (Sterne and Liepniece, 2010; Giongo *et al.,* 2013). Acid soils are required, ideally with a pH between 4.5 and 5.5 (Erb *et al.*, 1993), that are porous and loose with good drainage due to the slightly deep radicle system, generally restricted to the first 20 cm of the soil with narrow roots without hairs (Gough, 1994).

This fruit originated in North America has a notable antioxidant capacity, three times greater than strawberries or raspberries (Kalt *et al.*, 1999; Saftner *et al.*, 2008), and significant contents of anthocyanins and flavonoids (Jiménez-García *et al.*, 2013). These properties have generated great interest, especially in the nutra-pharmaceutical industry where it is known as the "super fruit" due to its prevention and treatment of neurodegenerative diseases, cardiovascular diseases, diabetes, and cancer, among others (Sinelli *et al.*, 2008; You *et al.*, 2011; Stevenson and Scalzo, 2012).

The more commercially cultivated blueberry species include *Vaccinium corymbosum* L., *V. ashei* Reade and

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V. angustifolium Aiton (Hancock, 2009; Retamales and Hancock, 2012; Scalzo *et al*., 2013). Since the 20th century, hybridization programs have been carried out in order to adapt blueberries to the conditions of different regions, as well as to find new and improved characteristics, such as vigor, disease resistance, production, flavor, fruit firmness, and chilling requirements (Hancock, 2009; Retamales and Hancock, 2012; Scalzo *et al*., 2013). There are blueberries cultivars for the Northern Hemisphere, the Southern Hemisphere, and half-high blueberry, which differ in the amount of chilling hours that is required for the development of flowers and in the ability to resist cold environments (Hancock, 2009).

Cultivars from the Southern Hemisphere indicate a cross between *V. corymbosum* L. × *V. darrowii* Camp., the latter of which has a lower chilling requirement, higher resistance to foliar diseases, and better adaptation to conditions with high temperatures and humidity (Chavez and Lyrene, 2009; Spann *et al.,* 2003). This hybrid is ideal for crops in tropical zones due to a chilling hour requirement that is below 1,000. The cultivars that predominate in the industry include 'Misty', 'Duke', 'Bluecrop', 'Legacy', 'O´Neal', 'Brigitta', 'Elliot', 'Star', 'Emerald', 'Biloxi' and 'Sharpblue', among others (Hancock, 2009; Borlando, 2012; Retamales and Hancock, 2012).

The United States is the largest producer and importer of blueberries worldwide (Brazelton, 2013; Marzolo and Geisler, 2015). The consumption per capita was 0.26 lb in 2000 and close to 1.3 lb in 2011 (Brazelton, 2013; Marzolo and Geisler, 2015). Interestingly, South America is notable due to its increasing production; between 2008 and 2012, there was an increase of 136%. This region, led by Chile, contributes one-quarter of the global production and is ranked as the second largest global production zone, following North America, with 14,800 cultivated hectares (Brazelton, 2013; Chilean Blueberry Committe, 2013).

The blueberry market is growing in countries such as Argentina, Uruguay, Peru and Brazil, which, along with Chile, have the benefit of a counterseason. Currently, Chile and, to a lesser extent, Argentina are the only exporters to consolidated markets, such as the United States (Brazelton, 2013; Fernández-Gutiérrez, 2014).

Colombia occupies the sixth place among the South American countries that produce blueberries with 25 ha cultivated in the departments of Cundinamarca and Boyaca, with all of the production going towards meeting the local consumption (Brazelton, 2013; Fernández-Gutiérrez, 2014). In this sense, the blueberry planting represents an opportunity in this country due to the possibility of continuous production that could meet the domestic demand and contribute to supplying the needs of northern countries in the winter months given the existing free trade agreements. It is important to note that, according to the *Centro de Excelencia Fitosanitaria* that belongs to *Instituto Colombiano Agropecuario* (ICA), the blueberry is one of the fruits from Colombia that are allowed entry in all of the ports of the United States (ICA, 2006). However, for Colombia, there is still not enough formal information for the cultivation of this species; for the most part, efforts have been focused on the productive sector that are isolated and with restricted divulgence.

In recent years, great advances have been made in the world for the development of new cultivars and studies on the behavior of genetic materials in different climate and crop conditions. Furthermore, the growing demand for blueberries, the appearance of new markets, and the increase in the demand for fruit quality necessitate a better understanding of production and postharvest processes in order to favor commercial success.

As such, this study aimed to compare the crop yield and some aspects related to fruit quality for the cultivars Biloxi and Sharpblue, cultivated in open fields in commercial crops established in the municipality of Guasca (Colombia).

Material and methods

This research was carried out between June and December of 2014 in a commercial blueberry crop located in Guasca (Colombia), at 4°52.868' N, 74°29.733' W and 2,700 m a.s.l. The average, high, and low temperatures recorded during the experiment were 12.85, 17.0 and 10.6°C, respectively; the average, high and low relative humidity was 84.87, 94.0 and 72.85%. The average annual precipitation in this zone is 640.8 mm with a bimodal pattern.

The crop was established using the cultivars Biloxi and Sharpblue, which came from a nursery in the United States. They were planted in elevated beds on natural soil that was covered with black plastic mulch. A fertigation system was used with one drip tape per bed, supplying a volume of 643 mL/plant per day for the 36-month-old plants and 386 mL/plant per day for the 20-month-old plants. The agricultural practices included hoeing the plants once per year and pruning carried out every two months that removed dead, diseased, and small diameter and short stems located close to the base of the plants. The disease and pest incidence was determined weekly; mainly mites, rust, and gray mold were seen, which were managed with integrated control practices according to the criteria of the producers. The crop was protected with birdnets in order to reduce fruit losses due to consumption by birds.

During this research, plants from two lots with different ages at the start of the study were observed: 20 months and 36 months. According to the literature, blueberry bushes start reproductive development soon after transplant; however, it is recommended that the flowers and fruits be removed during the first two years in order to improve the balance between the vegetative and the reproductive development and in order to increase the productive life of the shrub, which starts at an age of three years and reaches a maximum at 5 or 8 years (Maust *et al*., 1999; Molina *et al*., 2008). However, some commercial farms allow the production of blueberries to occur starting at an age of two years (Strik and Buller, 2005; Scalzo *et al*., 2013). In Colombia, some producers stop removing the flowers and fruits and start harvesting the fruit after the first year of establishment after transplant.

The 20-month-old bushes were planted at a distance of 0.8 m between the plants and 2.2 m between the bed centers, for a density of 5,600 plants/ha. The 36-month-old bluberries were planted at a distance of 1m between the plants and 2.2 m between the bed centers, for a density of 4,275 plants/ha.

For this experiment, 12 homogenous bushes were selected for each of the cultivars and for each crop age. For 28 weeks, the ripe fruits were handpicked from each bush weekly. The fruit harvest point was defined as a dark blue color because the fruits of this species are climacteric and their physiological maturity has been determined to occur with this color (Kalt and McDonald, 1996; Giongo *et al*., 2013). The accumulated yield per plant was determined, corresponding to the fresh weight of the fruits harvested during the 28-week period. In addition, the number of fruits harvested per plant was recorded, along with the individual weight of each fruit using a precision balance and the diameter or equatorial diameter using an analog caliper gauge. In order to determine the firmness, first, a portion of the epidermis approximately equal to the diameter of the device's probe was removed and the force needed to penetrate the part of the fruit without an epidermis was measured with a Force Gauge PCE-PTR-200 digital penetrometer with a 6mm probe, expressing the results in Newton (N). The firmness was estimated at four times during the experiment and was done on 30% of the total harvested fruits per plant. For the total soluble solids (TSS), on the five harvest dates, a subsample was taken that equaled 30% of the total harvested fruits per plant; the fruits in this subsample were cut in half, macerated, and finally filtered with a voile. The TSS concentration was estimated in the resulting juice with a HI 96801 digital refractometer, standardized with distilled water, expressing the results in Brix degrees.

The results, except for the firmness and TSS variable, were subjected to a combined analysis of variance, using two factors for each one with two levels: plant age (20 and 36 months) and cultivar (Biloxi and Sharpblue). The multiple comparisons were done with t-tests using the statistics software SAS 9.1.3 with the PROC GML procedure and LSM linear estimations (*least square mean*). For the firmness and TSS variables, an analysis of variance was done with repeated measurements during the time used for the PROC MIXED procedure. In order to analyze the relationship between the variables of yield and number of fruits per plant, linear regression was used with the Data Analysis-Regression tool in Excel 2013®.

Results and discussion

The accumulated yield per plant for the 28 weeks was statistically different between the cultivars in the 36-month-old plants, with 'Sharpblue' being higher at 2,443 g/plant as compared to 'Biloxi' with 1,531 g/plant ($P \leq 0.0001$), which represented an increase of 60%. The yield in the 20-month-old 'Sharpblue' plants was 991 g/plant and, for 'Biloxi', it was 737 g/plant, with the former being 34% higher; however, the yields of both were statistically similar ($P=0.1503$).

The yields obtained in the bushes of both cultivars and for both ages had a close relationship with the number of fruits, as seen in Fig. 1 where there is a clear relationship between these two variables.

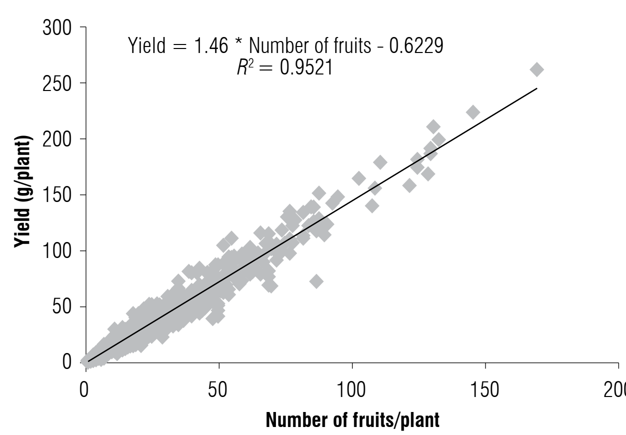

FIGURE 1. Linear regression between the yield and the number of harvested fruits per plant for the blueberry cultivars Biloxi and Sharpblue ($n=856$; $P \leq 0.001$).

In general, and as expected, the yield increased with the age of the plants, being higher in the 36-month-old plants, independent of the evaluated cultivar ($P \leq 0.0001$). Molina *et al.* (2008) reported that the maximum production of blueberry fruits is only reached in the 7th and 8th years of production, which is why plants tend to increase their yield as they increase in age.

These results agree with those obtained by Strik and Buller (2005), who evaluated the yield of plants that were 1 to 4 years in age from the southern cultivars 'Bluecrop', 'Duke' and 'Elliot', reporting higher yields in the plants with a higher age (4 years). According to these authors, young plants have less vegetative development and so cannot achieve high production, which is why they recommended removing the fruits from plants that are less than 2 years in age in order to promote vegetative growth and the formation of a root system.

In New Zealand, Scalzo *et al.* (2013) evaluated the yield of 'Blue Bayou', 'Sunset Blue', 'Blue Moon', 'Dolce Blue', 'Sky Blue', 'Central Blue' and 'Velluto Blue' for 5 years, eliminating the fruits for the first two years of the crop establishment. In five of the seven evaluated cultivars, the yield increased in the older plants, reaching an increase of up to 77%, as in the case of 'Central Blue'. On average, in the third, fourth, and fifth years, the yield was 2,425 kg/plant, 3,051 kg/plant and 3,355 kg/plant, respectively.

The yield per hectare, calculated based on the data obtained in this study from each plant for a period of 6 months and considering the plant density, would be 5,583 kg ha^{-1} for the 20-month-old 'Sharpblue' plants, 4,127 kg ha^{-1} for the 20-month-old 'Biloxi' plants, 10,443 kg ha^{-1} and 6,545 kg ha^{-1} for the 36-month-old 'Sharpblue' and 'Biloxi' plants, respectively. These values are close to those reported by the USDA (2013) for 2012 for blueberries, with a yield of 6,652 kg ha^{-1}, and are higher than those reported by Scalzo *et al.* (2013). According to these results, the yield seen in both cultivars under the conditions found in Guasca (Colombia) during this study can be considered promising. It is important to note that, under the conditions of the present study, the fruit harvest was continuous throughout the experiment (Fig. 2) and that similar reports only discuss one harvest season per year.

In both cultivars, the harvest peaks were concentrated in determined moments in the experiment (Fig. 2); possibly, these peaks were related to the flowering peaks that occurred in the previous periods, which were perhaps stimulated by periods of low precipitation in the study area. As reported by Fischer *et al.* (2012) for various fruit tree species in the tropics, floral induction occurs as a result of conditions of hydric stress or low temperatures.

When the cultivars were compared, the 'Sharpblue' bushes demonstrated a higher tendency to concentrate the production in harvest peaks that were more defined and higher in magnitude as compared to 'Biloxi' (Fig. 2). These results agree with those reported by Retamales and Hancock (2012) for these materials, where 'Sharpblue' was described as a cultivar with more vegetative vigor and more yield than

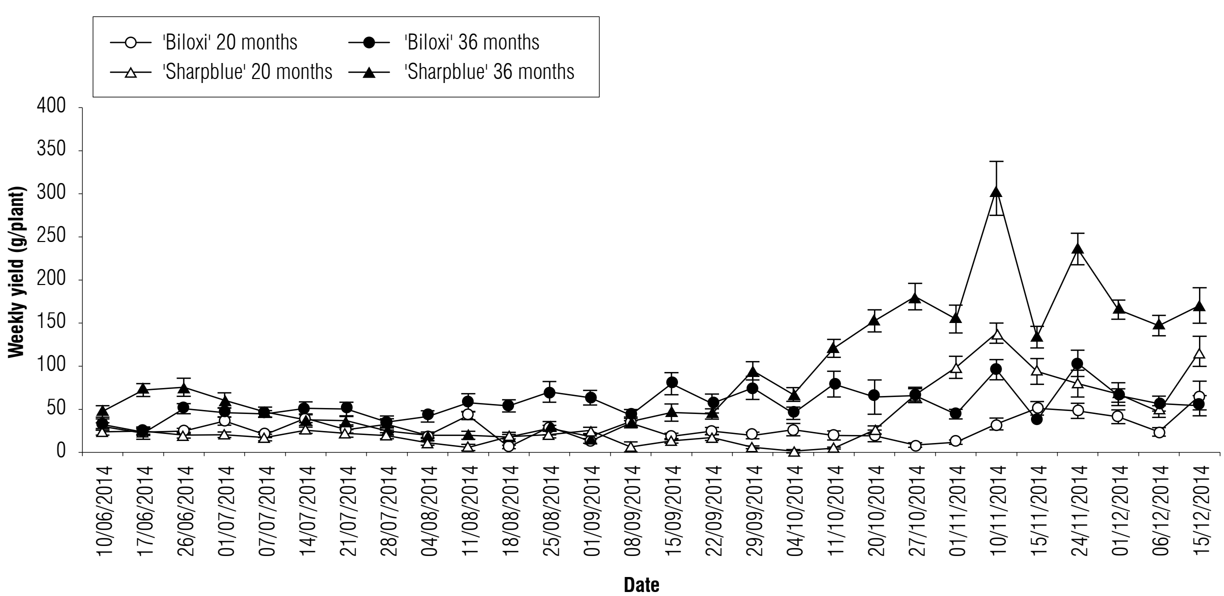

FIGURE 2. Weekly yield per plant for the two blueberry cultivars 'Biloxi' and 'Sharpblue' in 20-month-old and 36-month-old plants cultivated in Guasca (Colombia) for a period of 28 harvest weeks. Error bars indicate standard error.

'Biloxi'. Although 'Biloxi' had lower yields in this study, it is important to note that its production during the different harvest weeks was more consistent and constant than that seen with 'Sharpblue'.

In the firmness of the 20-month-old plants, at the statistical level, on the third (P=0.0053) and fourth (P=0.0422) evaluation dates, the 'Biloxi' fruits were firmer than the 'Sharpblue' fruits (Fig. 3). However, in the 36-month-old plants, there was no difference in the firmness of the fruits of the two cultivars (P>0.05) (Fig. 4). The literature indicates that the Biloxi cultivar is characterized by having fruits with an intermediate (Zee *et al*., 2006) to very firm firmness (Retamales and Hancock, 2012), while 'Sharpblue' fruits have intermediate firmness (Retamales and Hancock, 2012).

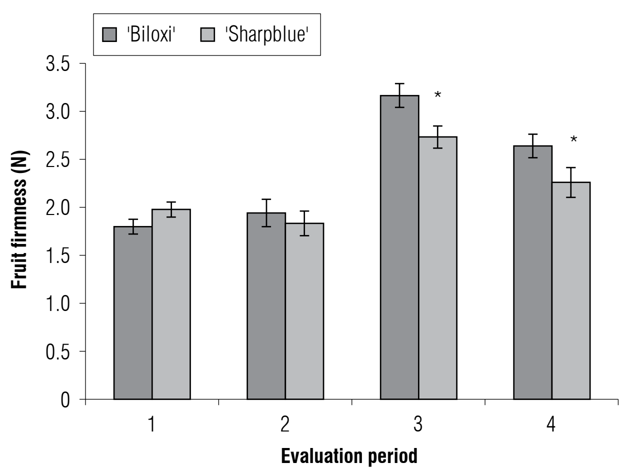

FIGURE 3. Firmness (N) in blueberry fruits harvested from the 20-month-old bushes of the cultivars Biloxi and Sharpblue in Guasca (Colombia). Means with asterisk indicate a significant difference between the cultivars according to the LSM estimation ($P\leq0.05$). Error bars indicate standard error.

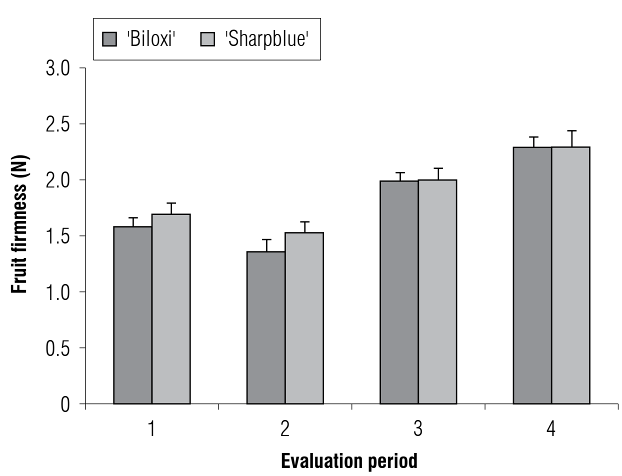

FIGURE 4. Firmness (N) in blueberry fruits harvested from the 36-month-old bushes of the cultivars Biloxi and Sharpblue in Guasca (Colombia). Error bars indicate standard error.

In general, the higher firmness values were obtained in the 20-month-old plants rather than in the 36-month-old plants. This may have been due to a smaller amount of competition for photoassimilates, resulting from a lower number of fruits (or sinks) that is seen in younger plants, as has been reported for other species (Link, 2000; Taiz and Zeiger, 2010).

The mean firmness of the fruits in the Biloxi cultivar was 2.1 N and 2.07 N for the 'Sharpblue' fruits. These values are higher than those reported by Molina *et al.* (2008) for the southern cultivars 'O´Neal', 1.23 N, 'Misty', 1.25 N and 'Sharpblue', 1.19 N, cultivated in Andalucia, Spain.

On average, the TSS content of the harvested fruits was in a range of 12.4 to 14.5 °Brix for the two cultivars in the two evaluated ages. In the 20-month-old plants, there were no differences between the evaluated cultivars, with a mean of 13.6°Brix for 'Biloxi' and 13.58°Brix for 'Sharpblue' (Fig. 5).

In the 36-month-old plants (Fig. 6), 'Sharpblue' demonstrated a tendency to present higher values than 'Biloxi'; however, the TSS values were only statistically higher in the first ($P\leq0.05$) and in the fifth ($P\leq0.01$) evaluation dates. This behavior has been reported in other studies, where TSS values of this cultivar were higher in comparison with other southern cultivars (Lang and Tao, 1992; Zee *et al.*, 2006; Aung *et al*., 2014). Authors such as Zee *et al.* (2006) in Waimea, Hawaii, have registered TSS values of 14.92°Brix for 'Sharpblue'. Aung *et al.* (2014), in a study in Japan that evaluated the behavior of different blueberry cultivars exposed to natural light and artificial light, obtained TSS

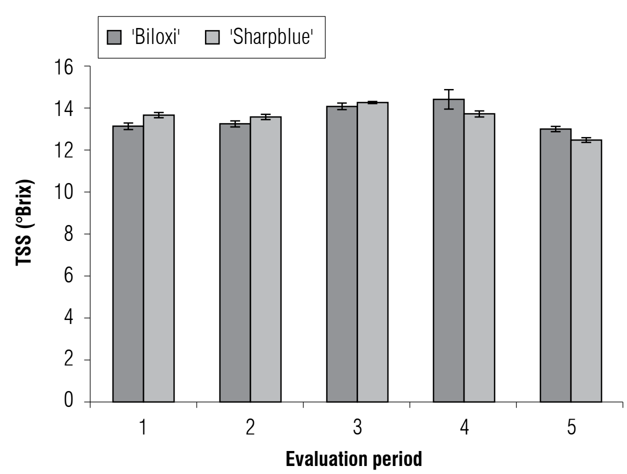

FIGURE 5. Total soluble solids content (TSS) in blueberry fruits collected with the harvest criterion of blue fruits, from 20-month-old bushes of the cultivars Biloxi and Sharpblue in Guasca (Cundinamarca). Error bars indicate standard error.

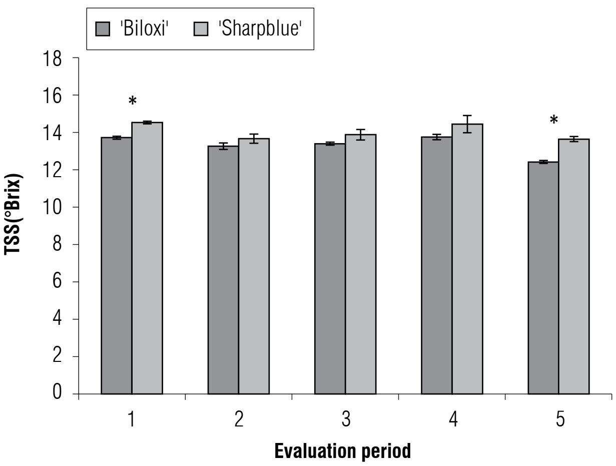

FIGURE 6. Total soluble solids content (TSS) in blueberry fruits collected with the harvest criterion of blue fruits, from 36-month-old bushes of the cultivars Biloxi and Sharpblue in Guasca (Cundinamarca). Means with asterisk indicate a significant difference between the cultivars according to the LSM estimation ($P \leq 0.05$). Error bars indicate standard error.

values of 14.8°Brix for 'Sharpblue' in natural light and 13.7°Brix in artificial light. Molina *et al*. (2008) obtained a TSS value of 12.4°Brix for this cultivar in Andalucia, Spain.

Generally, the results obtained in this study for the two cultivars and for the two ages were higher than those reported by authors such as Zee *et al*. (2006) for 'Biloxi' (12.27°Brix), Ogden and Iersel (2009) for other southern cultivars such as 'Emerald' (12.81°Brix) and 'Jewel' (11.5°Brix), Hancock *et al*. (2009) for 'Bluegold', 'Brigitta', 'Elliott', 'Legacy' (11.4 to 13.7°Brix), Saftner *et al*. (2008) for 'Duke' (10.9°Brix) and 'Bluecrop' (11.5°Brix), Gündüz *et al*. (2015) for the southern cultivars 'Springhigh' (11.33°Brix), 'Star' (13.47 °Brix) and 'Sharpblue' (13.33°Brix) and Lang and Tao (1992) for the 'Sharpblue' cultivar (11.6°Brix).

Blueberry fruits cultivated in the high tropics have a higher TSS content due to the fact that these zones have higher levels of sunlight than at other altitudes (Fischer *et al*., 2012), which increase the photosynthetic rate (Taiz and Zeiger, 2010), resulting in an increase in the concentration of soluble solids (Hopkirk and Triggs, 1986; Vasconcelos and Castagnoli, 2000; Jifon and Syversten, 2001). Another factor that can influence the TSS content results from the decrease in respiration caused by the low temperatures seen in zones such as high tropics, which promotes the synthesis and accumulation of carbohydrates in fruits (Mackenzie *et al.,* 2011).

The 20-month-old plants had similar values for the individual fresh weight of the fruits in both cultivars, with 1.55 g for Biloxi and 1.5 g for Sharpblue. In the 36-month-old plants, 'Biloxi' had a mean weight of 1.39 g and 'Sharpblue' had a weight of 1.42 g.

The individual weight of the 'Sharpblue' fruits found in this study was lower than that reported by Gündüz *et al*. (2015) with 1.82 g. Nevertheless, this study agrees with the reports by Molina *et al*. (2008) in Andalucia (Spain), working with 4 and 5-year-old blueberry plants and by Parra *et al*. (2007) in Spain for 10 and 3-year-old plants. However, this result was higher than that obtained by Lang and Tao (1992), 1.33 g, in Louisiana (United Sates) with 4-year-old plants.

According to Zee *et al*. (2006), 'Sharpblue' produces medium-sized fruits and 'Biloxi' produces medium-sized to small-sized fruits, as demonstrated through the characterization of six southern cultivars, where the higher fruit weights were obtained with 'Misty' (2.52 g), 'Jewel' (2.13 g), 'Emerald' (1.99 g) and 'Sapphire' (1.65 g) and the lower weights were obtained with 'Biloxi' (1.51 g) and 'Sharpblue' (1.28 g).

As reported by Molina *et al*. (2008), blueberry fruits must have a weight over 0.75 g in order to be accepted in the market. With this reference, the fruits of the studied cultivars under the conditions of the present study would have good commercial acceptance in terms of their size.

Fruit weight and diameter are two of the more representative quality parameters for the commercial blueberry market. As reported by various authors, such as Saftner *et al*. (2008), Retamales and Hancock, (2012) and Scalzo *et al*. (2013) cultivars that have good production are more accepted in the market if they also produce good-sized fruits, which make the harvest easier for the workers and allow boxes to be filled with a lower number of fruits. Likewise, visually speaking, a larger-sized fruit has a positive effect on the consumer (Parra *et al.,* 2007; Sterne and Liepniece, 2010; Retamales and Hancock, 2012).

In the 20-month-old plants, the 'Biloxi' fruits had a mean diameter of 1.5 cm; 20% of the total harvested fruits had this diameter, followed by 17.9% with a diameter of 1.4 cm. 'Sharpblue' had a similar mean diameter of 1.5 cm, but the highest percentage of harvest fruits, 17.8%, had a diameter of 1.3 cm, followed by a diameter of 1.5 cm at 17.3%. The range of diameters recorded for both cultivars was between 0.9 cm and 2.2 cm for 'Biloxi' and between 0.9 and 2.1 cm for 'Sharpblue'. The distribution percentage of the harvested fruits in each of the diameter categories was very similar for both cultivars (Fig. 7).

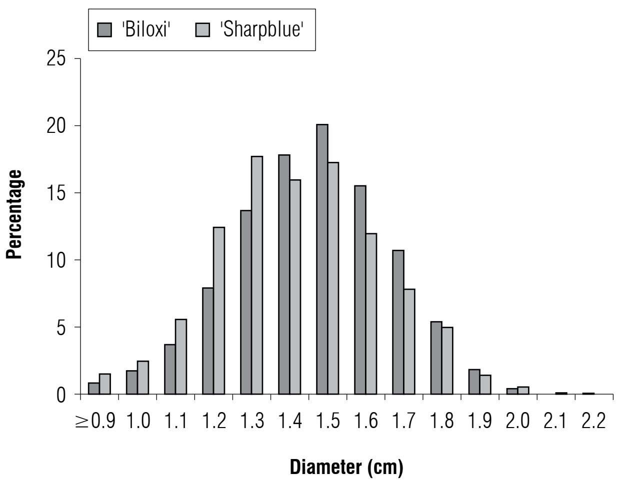

FIGURE 7. Percentage of the total harvested fruits that belonged to each diameter (cm), collected from 20-month-old blueberry bushes of the cultivars Biloxi and Sharpblue in Guasca (Colombia).

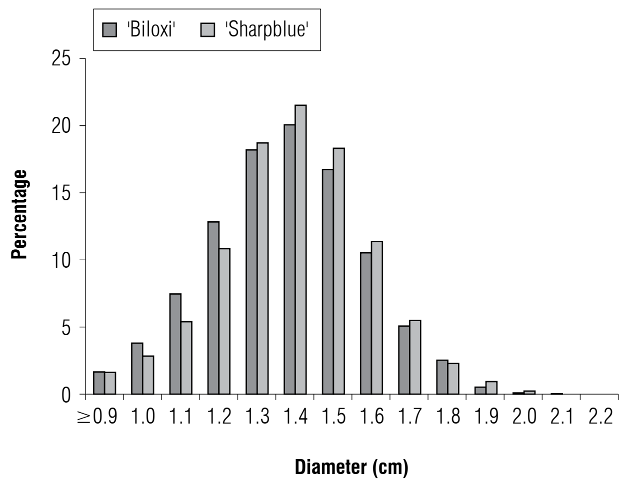

FIGURE 8. Percentage of the total harvested fruits that belonged to each diameter (cm), collected from 36-month-old blueberry bushes of the cultivars Biloxi and Sharpblue in Guasca (Colombia).

In the 36-month-old plants, both cultivars had a similar diameter, with a mean of 1.4 cm, and both had the highest percentages of harvested fruits in the diameters of 1.3 and 1.4 m. The diameter range recorded for both cultivars was between 0.9 and 2.1 cm for 'Biloxi' and between 0.9 and 2.0 cm for 'Sharpblue' (Fig. 8).

These results agree with the reports from Lang and Tao (1992), Molina *et al.* (2008) and Aung *et al.* (2014) for the Sharpblue cultivar, which stated mean diameters of 1.40, 1.46 and 1.45 cm, respectively.

Jordan and Eaton (1995) proposed a classification of five commercial categories for blueberry fruits based on fruit diameter: <4.0 mm; 6.3-4.0 mm; 8.0-6.3 mm; 9.5-8.0 mm and >9.5 mm. According to this classification, all of the fruits harvested from both cultivars corresponded to fruits with a diameter greater than 9.5 mm.

Conclusions

The Sharpblue cultivar presented a higher accumulated yield in the 36-month-old plants, as well as higher TSS values, making it a promising cultivar under the conditions and timeframe of this study.

The fruits of the Biloxi and Sharpblue cultivars presented a similar behavior in terms of the individual weight and diameter of the fruits and the firmness.

The 'Sharpblue' plants of both crop ages demonstrated a higher tendency to concentrate the production in harvest peaks that were more defined and of a higher magnitude in comparison to 'Biloxi'.

The yield of the crop and the quality of the harvested fruits in the two cultivars under the conditions of this study presented consumption characteristics at maturity that would allow them to be competitive in international markets.

For subsequent studies, it is recommended that crop yields be observed for longer periods of time, evaluating plants that are close to the age of maximum production, as reported in the literature, between 5 and 8 years, and quantifying the effect of starting early fruit production in young bushes, such as 20-month-old bushes, can have on the productive life of the plants in the long term. Similarly, evaluating other blueberry cultivars is suggested, especially those considered to be southern cultivars, in order to record the behavior of these materials in different locations throughout Colombia.

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