Influence of Silicon application on agronomic and nutritional performance of container grown highbush blueberries

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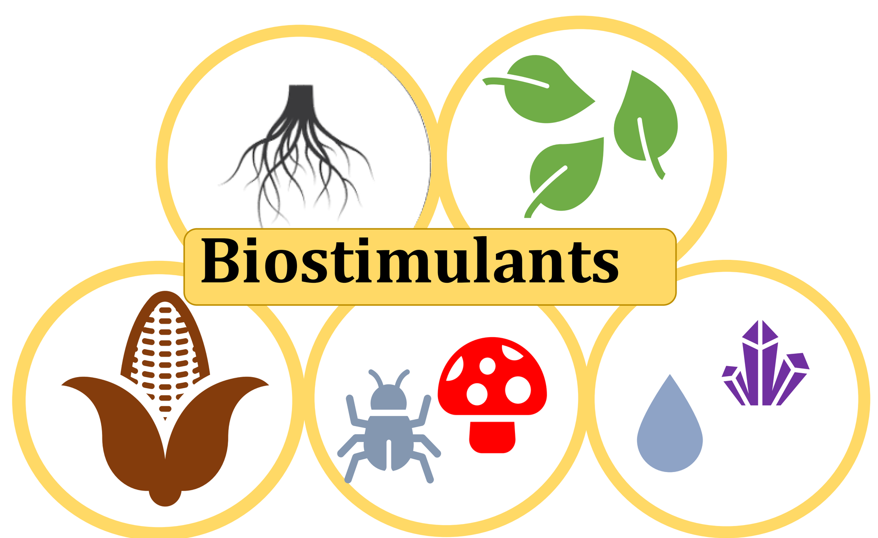
INTRODUCTION



- Better root development
- Enhanced nutrient uptake
- Higher crop quality and yield
- Alleviate abiotic and biotic stresses

Silicon as a Biostimulant

- Mitigating nutrient imbalance as well as drought and salinity stresses
- Reduce plant diseases

Challenges for Organic Blueberries

Improve both plant nutrition management and quality attributes of berries

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Health-promoting compounds in fruits are frequently associated to secondary metabolites responsible for plant defense. Si has the potential to enhance the nutritional value of berries by increasing sugar content and phenolic compounds in specific crops. (Wang et al. 2018)

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Healthy plants and berries of high quality!

AIM

Assess the silicon absorption capacity in eight highbush blueberry cultivars when supplied as Wollastonite (organic certified form of Si) versus potassium silicate.

MATERIALS & METHODS

In a split-plot design over one growing season, we compared in a greenhouse complex two type of silicon sources and one control containing no silicon: Wollastonite ($CaSiO_3$ – 52% SiO_2) at a rate of 4g/L of growing media and potassium silicate (K_2SiO_3 – 25% SIO2) at 0.3mL L^{-1} of irrigation solution.

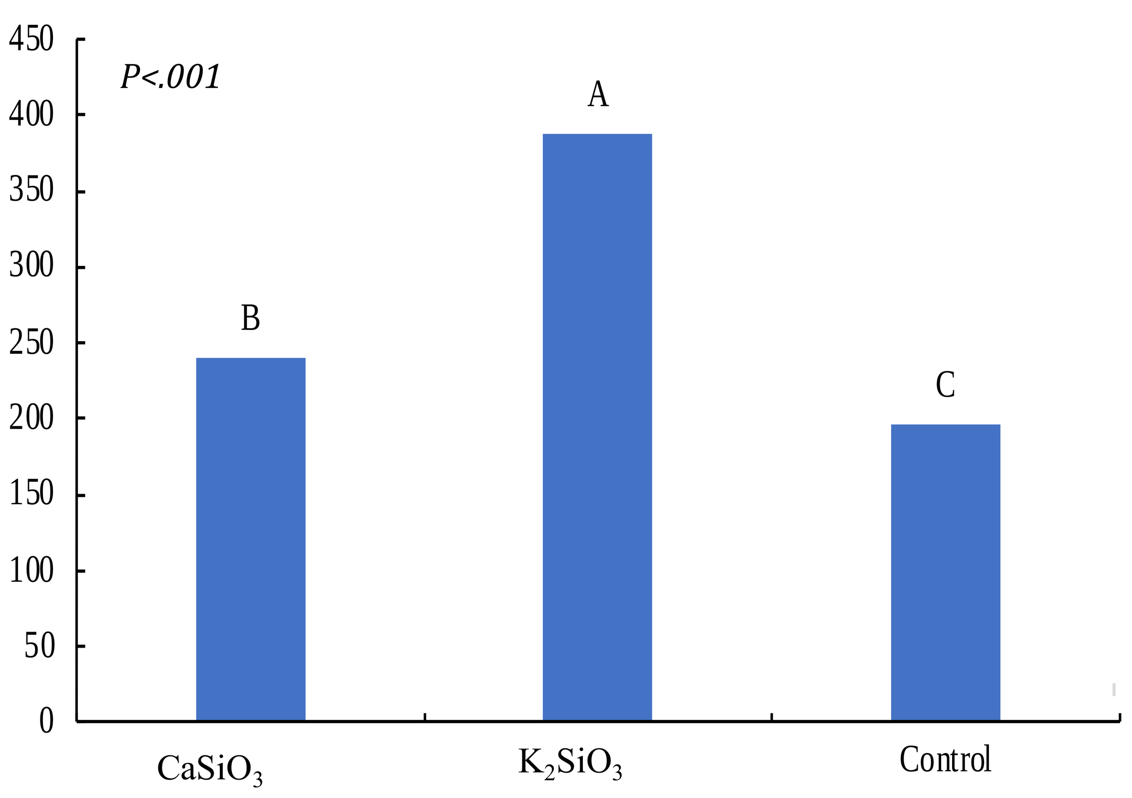

***Figure 1** Silicon leaf content (ppm) based on different silicon sources.*

MATERIALS & METHODS

- Bluecrop
- Bluejay
- Blueray
- Bluegold
- Duke
- Earliblue
- Liberty
- Spartan

10L containers
Organic Peat-Based Growing Media (Berger)
Dripping systems

Fertigation/Fertilizers

- Nature Source's 10-4-3 + K_2SO_4
- Nature Source's 10-4-3 + K_2SO_3Si
- Poultry Pellets

pH : 4.5-5.0; EC K_2O_3Si solution : 0.7 mS cm^{-1} ; EC Organic solution : 0.3 mS cm^{-1}

Parameters mesured

Growth and productivity
- Yield and fruit size

Fruit qualities
- Soluble sugar content, anthocyanin and polyphenol contents

Plant Physiology and Growing Media evolution
- Growth measurements
- Leaf chemical analysis
- SME and FDA analysis

Statistical analysis

- ANOVA using SAS v. 9.4, with a significance threshold of P ≤ 0.05.
- Data normality : Shapiro-Wilk test
- Mean comparisons were performed using Fisher's protected LSD test.

RESULTS

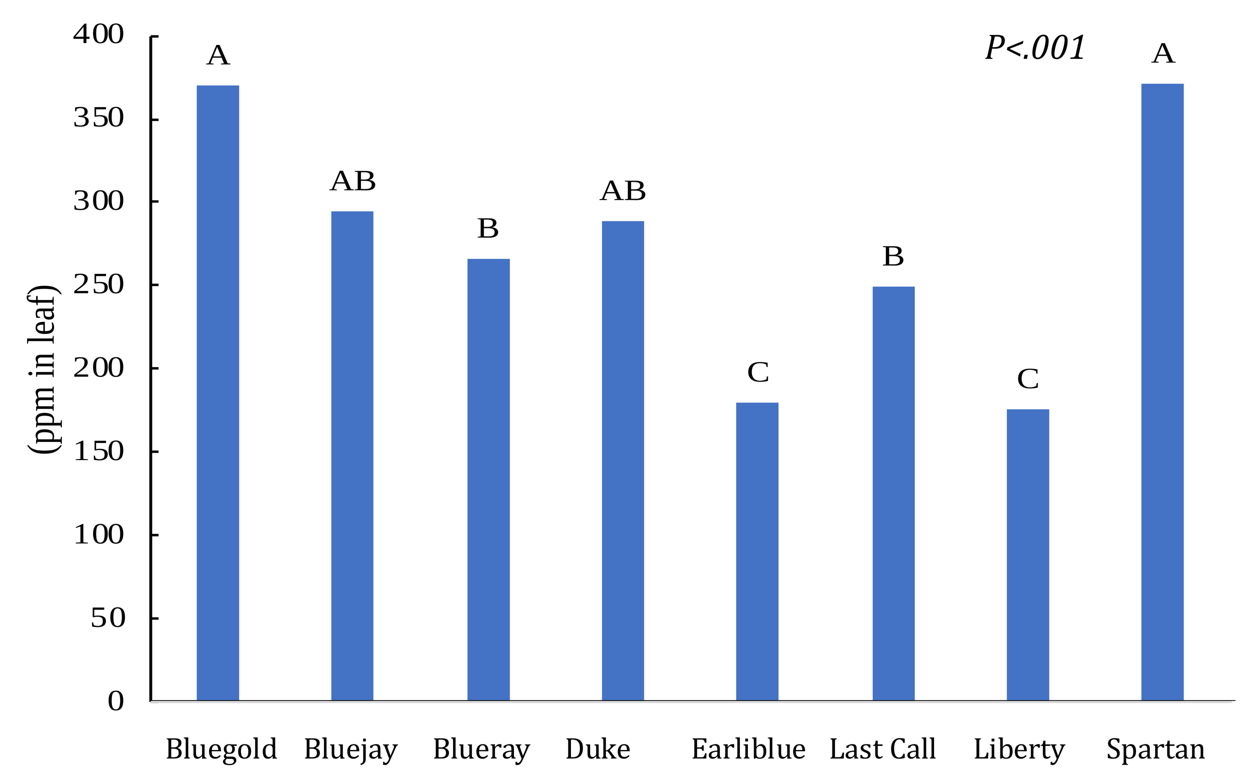

***Figure 2** Silicon leaf content (ppm) measured in each cultivars.*

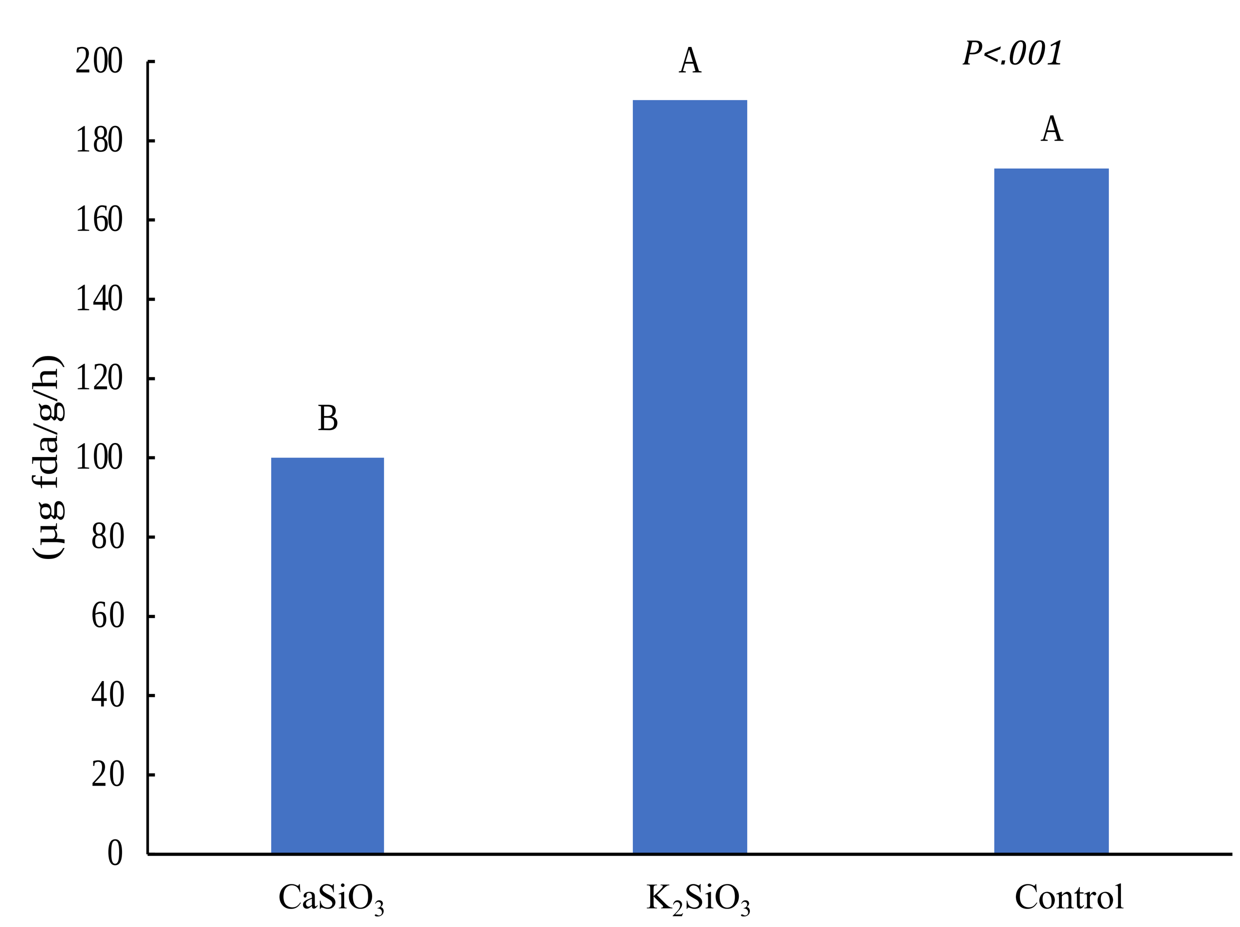

***Figure 3** Microbial enzymatic activity (FDA) for silicon sources*

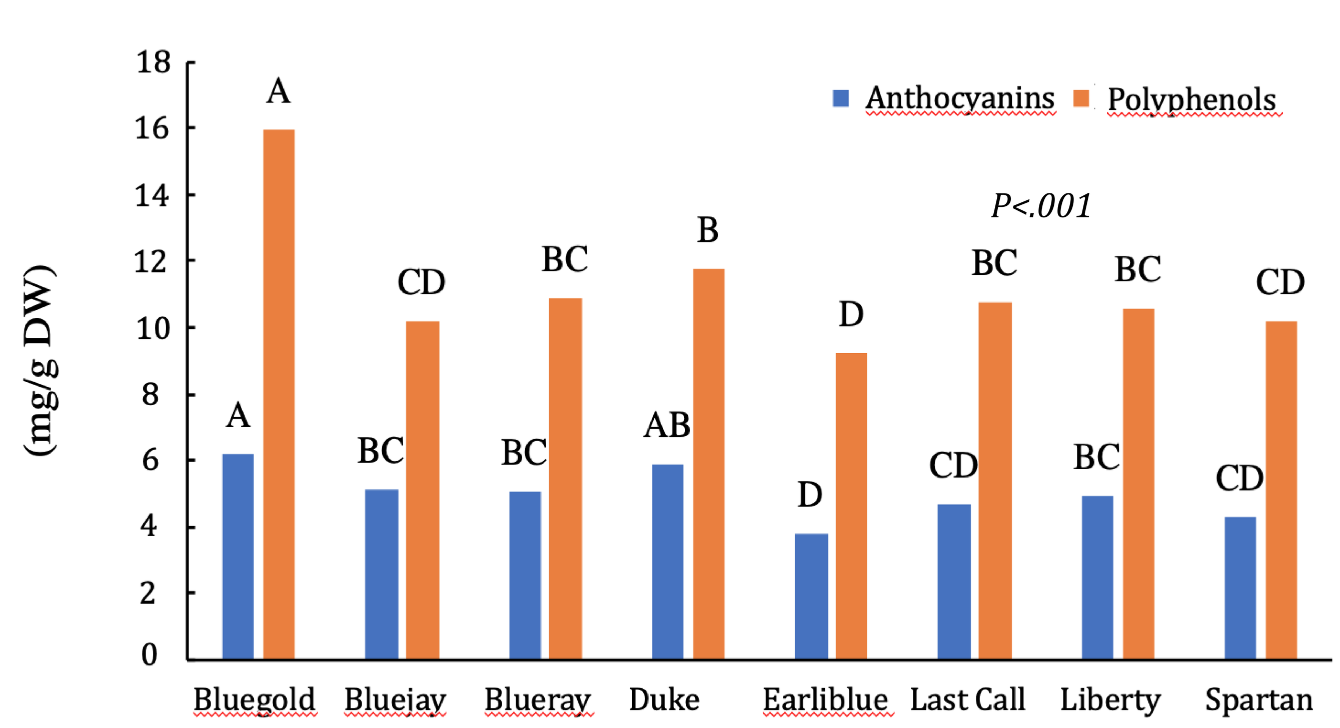

***Figure 4** Anthocyanin and Polyphenol content in berries of eight cultivars. Distinct letters indicate significant differences in anthocyanin or polyphenol content between cultivars.*

- When applying silicon to container-grown highbush blueberries, it was observed that potassium silicate (K_2SiO_3) was absorbed in larger quantities than wollastonite, as indicated by the silicon content in the leaves (*Fig. 1*).
- The silicon content in the leaves varied significantly among different cultivars, with differences exceeding 2.09 times. For example, Bluegold and Spartan had the highest Si content, while Earliblue and Liberty displayed the lowest leaf Si content. The remaining cultivars fell within the average range. (*Fig. 2*).
- K_2SiO_3 and control had beneficial impact on microbial enzymatic activity, as indicated by the increase in FDA when compared to $CaSiO_3$ (*Fig. 3*).
- The mean total yield per plant was lower for plants treated with the two silica treatments, with 386 g/plant for $CaSiO_3$ and 397 g/plant for K_2SiO_3, while the control yielded 428 g/plant.
- Earliblue exhibited the lowest levels of polyphenols, anthocyanin and Si (*Fig. 2&4*). In contrast, Bluegold had the highest Si content (371 ppm) with the highest levels of polyphenol (16 mg/g DW) and anthocyanin (6.2 mg/g DW). However, this trend was not observed for Spartan, as no relationship was identified between Si and the polyphenol and anthocyanin content in berries.

CONCLUSION

In this study, we showed that eight **highbush blueberry cultivars accumulated Si at three different levels** with a preference for the K_2SiO_3 form. K_2SiO_3 had a positive impact on microbial enzymatic activity suggesting that it may create optimal growth conditions for microorganism.

The application of silicon had a **negative impact on yield**, necessitating a more thorough evaluation to understand the unfavorable growth conditions that resulted in lower yields when silicon was applied.

Silicon could be used as a biostimulant with the additionnal role of **increasing beneficial antioxidant levels** as seen by the increased levels of anothocyanins and polyphenols in fruits. This could provide better fruits qualities for customers and have a positive impact on health conditions.

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