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Effects of a glutamic acid-based biostimulant on leafy vegetables physiology and produce quality

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INTRODUCTION

Cropping systems have been evolving towards organic, sustainable, and environmental friendly managements. The aim of modern agriculture is to reduce inputs without decreasing crop performance and produce quality. Biostimulants contain bioactive compounds, most of which unknown, able to promote plant development, growth, and tolerance to abiotic stresses. Biostimulants usually increase the nutrient use efficiency (NUE) of plants, reducing the fertilizers supply and, as a consequence, the environmental impact. Moreover, in leafy vegetables particularly susceptible to nitrates accumulation, biostimulants can improve the assimilation and limit their concentration in leaves, maintaining the levels below the EU law limits (EU n. 1254/2011). Biostimulant products can be applied as spray treatments or by soil drench. Therefore, biostimulants can act directly on plants or by improving the soil properties. Aim of this work was to study the effect of the biostimulant prototype GHI_16_VHL (Green Has Italia) containing amino acids of vegetal origin, in particular glutamic acid.

MATERIALS AND METHODS

The experiments were carried out on wall-rocket (*Diplotaxis tenuifolia* L.) grown in floating system using a nutrient solution with the following composition (concentrations are expressed in mM): 6 N-NO_3, 1.9 N-NH_4, 1.4 P, 4.2 K, 1.75 Ca, 0.7 Mg, and Hoagland's concentration for micronutrients. The biostimulant prototype GHI_16_VHL (VHL) was tested at two doses (2.45 and 3.7 mM glutamic acid equivalent) and compared to reference solutions containing the same doses of glutamic acid (GA). Control plants were sprayed with distilled water. Treatments were foliar applied in the middle of the growing cycle and one day before harvest. The experiment was carried out in greenhouse during spring-summer period and autumn, to evaluate the physiological and biochemical responses of crop in different climatic conditions.

RESULTS AND DISCUSSION

The applications of VHL and GA provided consistent and promising results in both cultivation cycles considered. The yield was higher in the VHL treated plants at both concentrations (Fig.1) and results were similar in both growing cycles. The positive effect was also evident on leaves chlorophyll concentration (+18-21%); differences were statistically significant in the autumn growing cycle (Fig. 2). Analogous trend was observed for carotenoids (Fig. 3). The photosynthetic activity increased by +21-26% as well as the water use efficiency (+18-40%), and statistically significant differences were observed in the autumn cycle (Fig. 4 and 5). Leaf nitrate levels were significantly reduced by treatments, particularly in the autumn cycle, by GA 2.45 mM, with 1750 mg/kg FW (Fig. 6). The oscillation of content has to be considered on the different organication rate of nitrate and light intensity. Sucrose concentrations were positively influenced by treatments (Fig. 7) and this aspect could have positive effects on the storage and on the shelf life of produce. Total phenols and anthocyanins slightly increased in GA treatments, but no significant differences were observed (data not shown).

In conclusion, GA and VHL positively affected wall-rocket by increasing the primary metabolism such as photosynthetic activity and related pigments. These effects improved yield and water use efficiency of the considered crop.

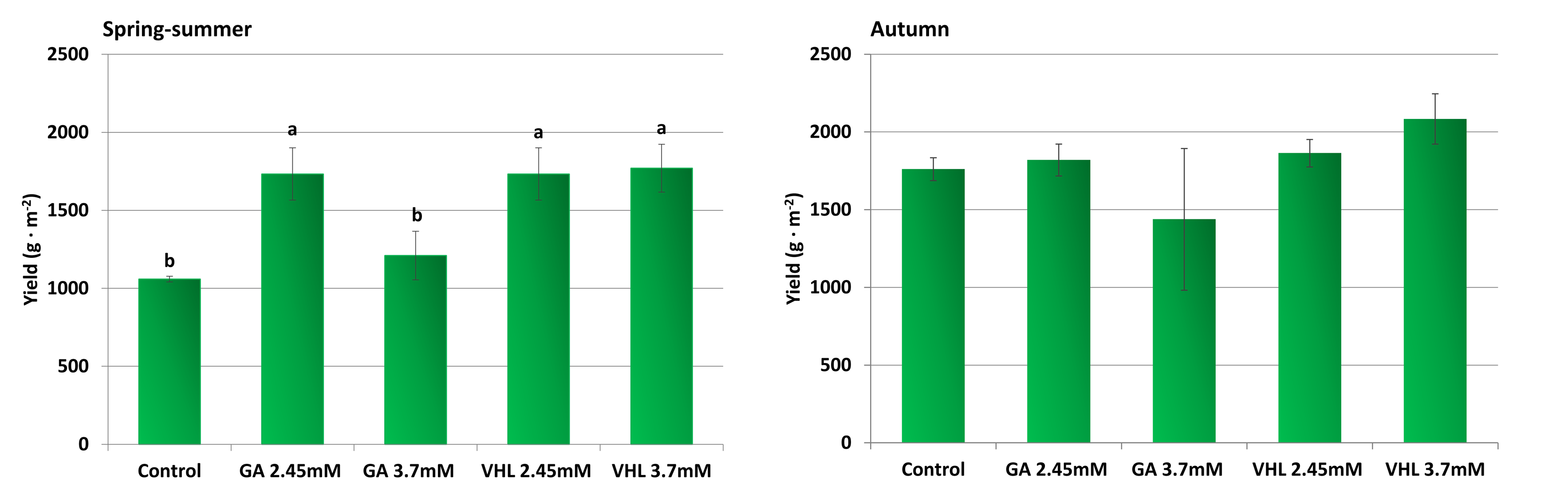

Figure 1. Yield of wall-rocket sprayed with distilled water (control), glutamic acid (GA 2.45 mM or 3.7 mM), and VHL containing 2.47 mM or 3.7 mM of glutamic acid (VHL 2.45 mM or VHL 3.7 mM). Values are means with standard errors. Different letters indicate significant differences (P<0.05).

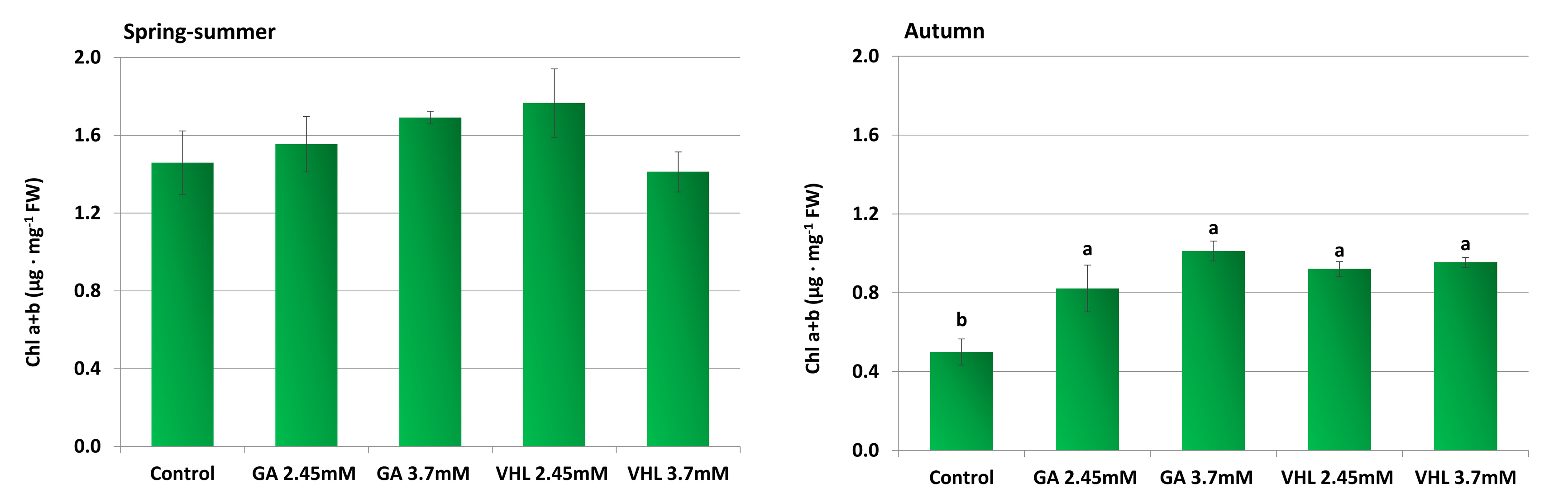

Figure 2. Chlorophyll *a+b* content of wall-rocket leaves sprayed with distilled water (control), glutamic acid (GA 2.45 mM or 3.7 mM), and VHL containing 2.47 mM or 3.7 mM of glutamic acid (VHL 2.45 mM or VHL 3.7 mM). Values are means with standard errors. Different letters indicate significant differences (P<0.05).

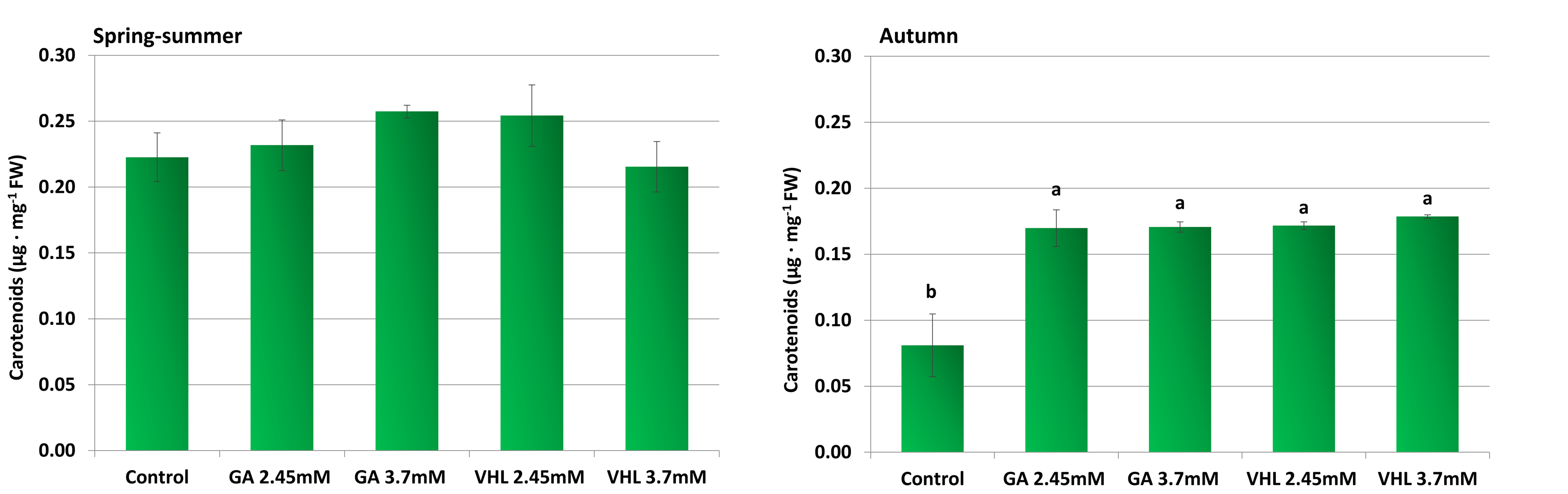

Figure 3. Carotenoids content of wall-rocket leaves sprayed with distilled water (control), glutamic acid (GA 2.45 mM or 3.7 mM), and VHL containing 2.47 mM or 3.7 mM of glutamic acid (VHL 2.45 mM or VHL 3.7 mM). Values are means with standard errors. Different letters indicate significant differences (P<0.05).

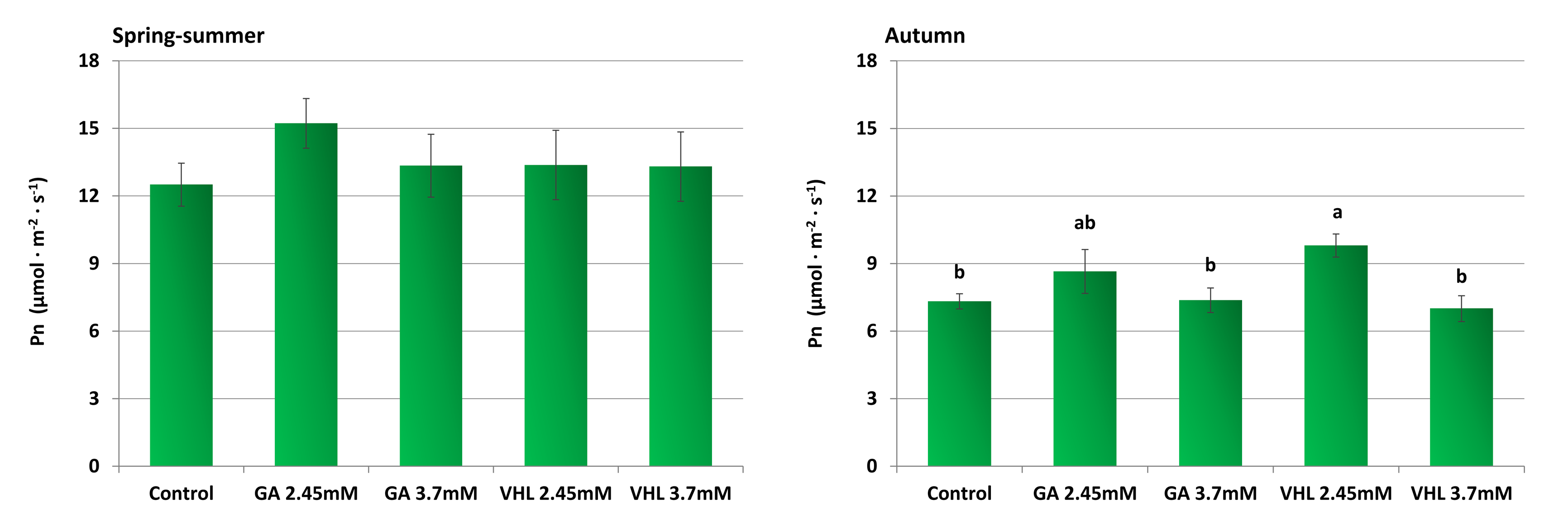

Figure 4. Net photosynthesis of wall-rocket plants sprayed with distilled water (control), glutamic acid (GA 2.45 mM or 3.7 mM), and VHL containing 2.47 mM or 3.7 mM of glutamic acid (VHL 2.45 mM or VHL 3.7 mM). Values are means with standard errors. Different letters indicate significant differences (P<0.05).

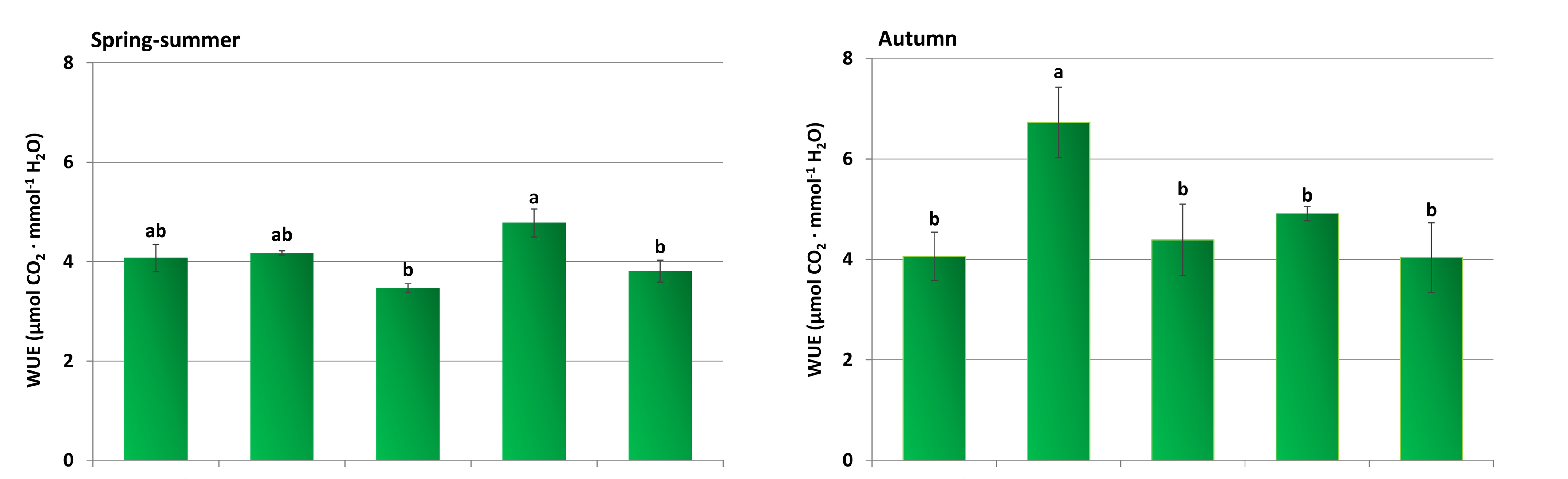

Figure 5. Water use efficiency (WUE) of wall-rocket plants sprayed with distilled water (control), glutamic acid (GA 2.45 mM or 3.7 mM), and VHL containing 2.47 mM or 3.7 mM of glutamic acid (VHL 2.45 mM or VHL 3.7 mM). Values are means with standard errors. Different letters indicate significant differences (P<0.05).

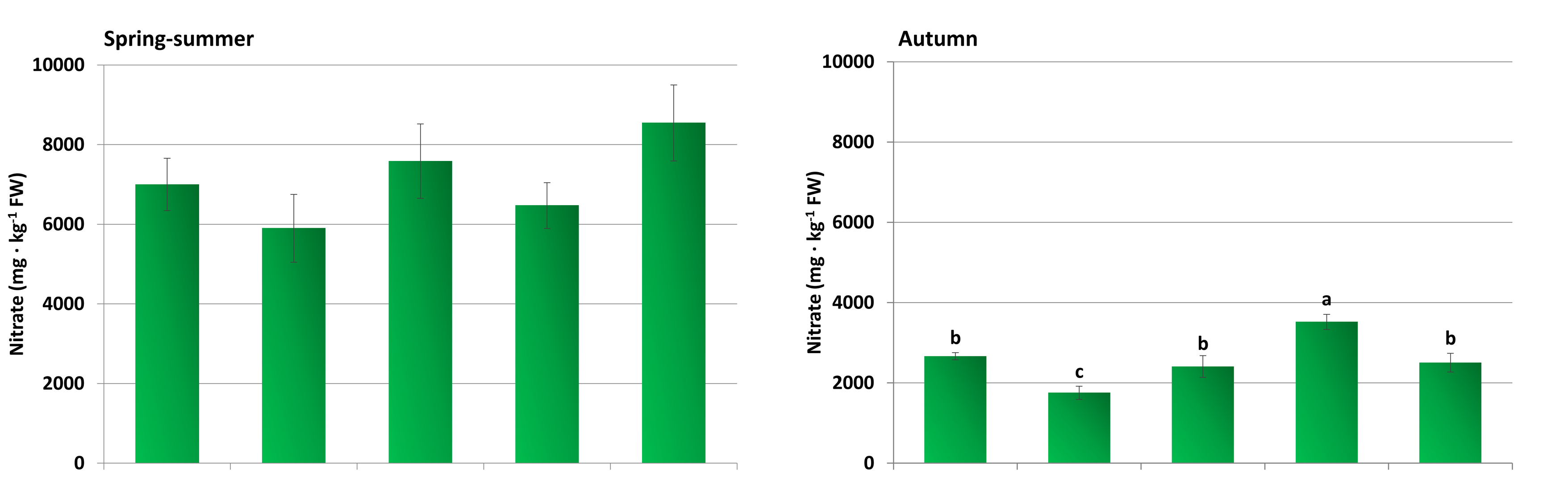

Figure 6. Nitrate concentration of wall-rocket leaves sprayed with distilled water (control), glutamic acid (GA 2.45 mM or 3.7 mM), and VHL containing 2.47 mM or 3.7 mM of glutamic acid (VHL 2.45 mM or VHL 3.7 mM). Values are means with standard errors. Different letters indicate significant differences (P<0.05).

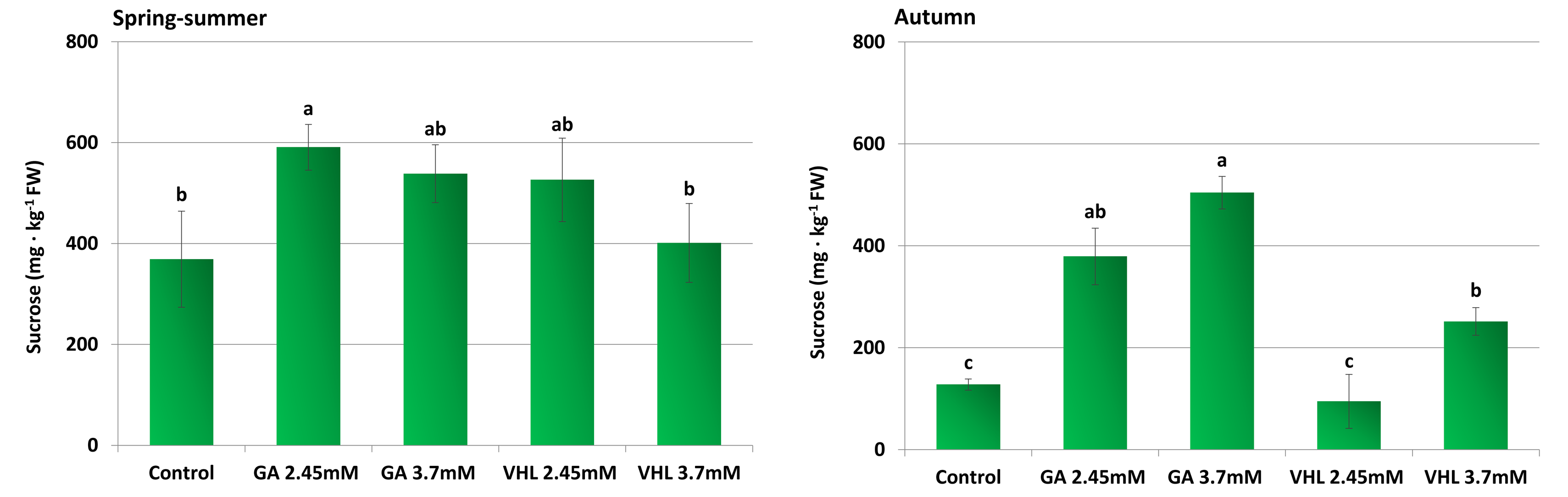

Figure 7. Sucrose content of wall-rocket leaves sprayed with distilled water (control), glutamic acid (GA 2.45 mM or 3.7 mM), and VHL containing 2.47 mM or 3.7 mM of glutamic acid (VHL 2.45 mM or VHL 3.7 mM). Values are means with standard errors. Different letters indicate significant differences (P<0.05).

Figure 8. Detail of the system of cultivation adopted for wall-rocket.