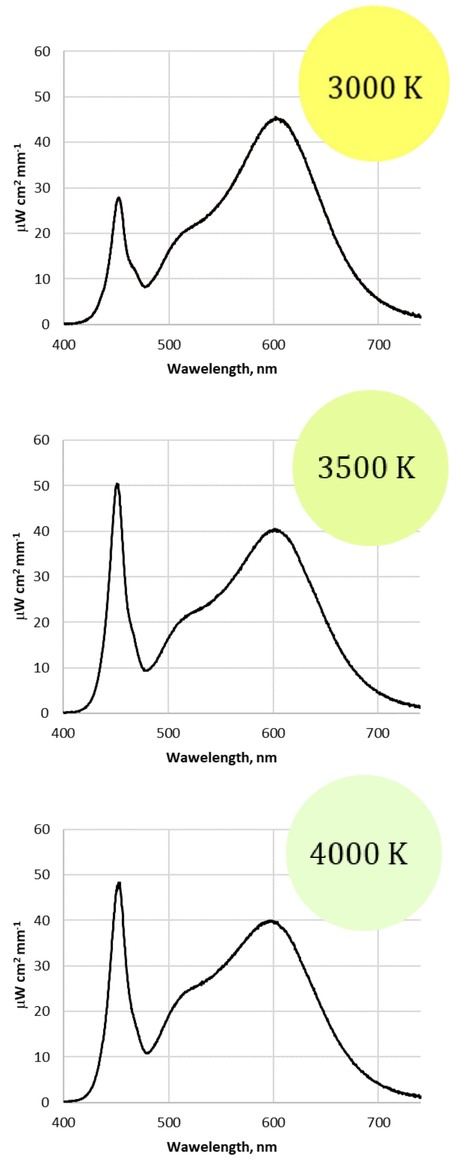
Response of lettuce to Se biofortification under different white LEDs lighting

A. Brazaitytė, V. Vaštakaitė-Kairienė, R. Paulauskaitė, K. Laužikė, K. Stašytė, P. Duchovskis
Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry, Babtai, Kaunas distr., Lithuania,
e-mail: Ausra.Brazaityte@lammc.lt

Lettuce *Lactuca sativa*, 'Little Gem'

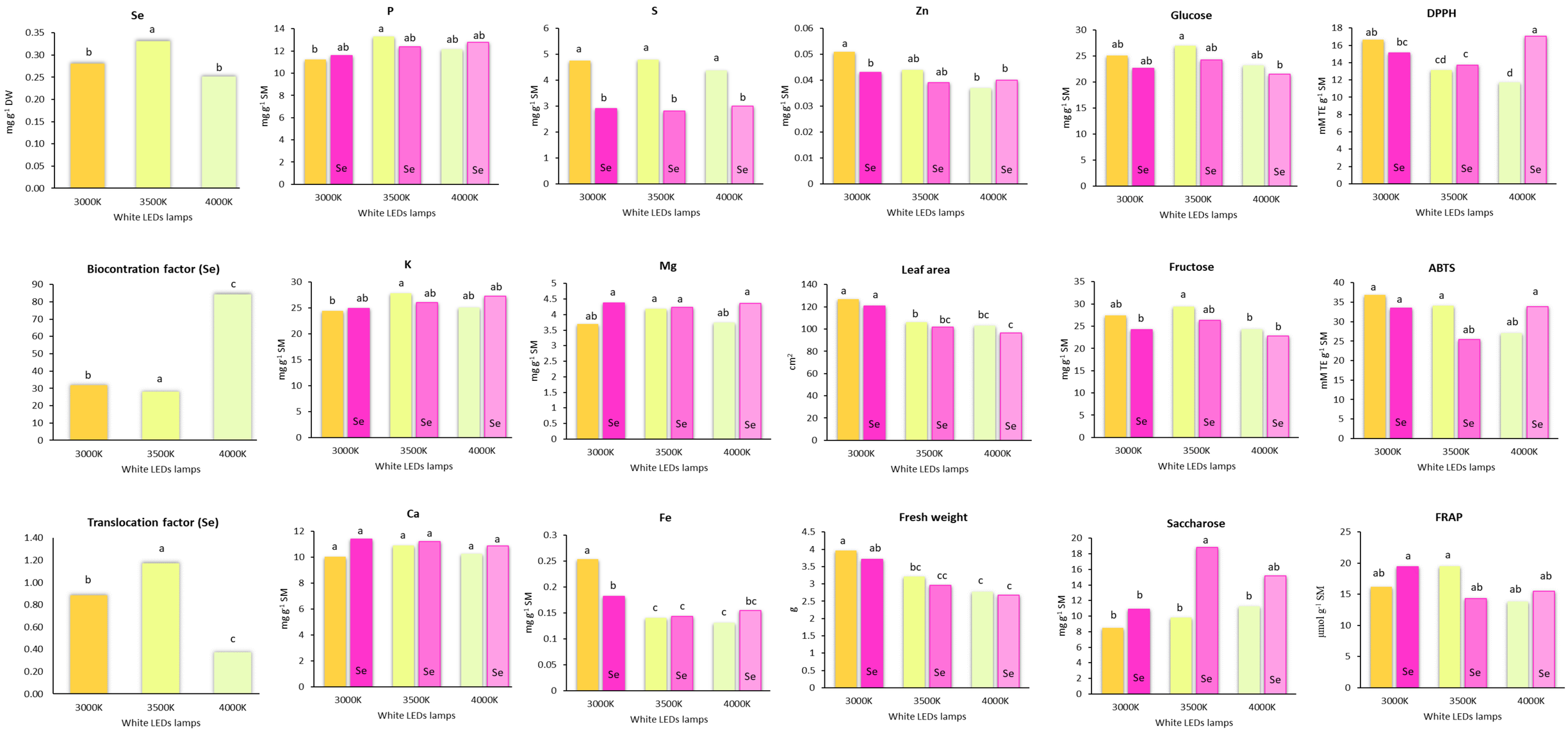


Spectrum of white LEDs

Introduction. Selenium (Se) is an essential trace element for human health acting as an antioxidant, helping reduce the risk of chronic and cardiovascular diseases, etc. Enrichment of hydroponic nutrient solution with Se is one of the way for the enhancement of Se in leafy vegetables. The study aimed to determine the responses of lettuce (Lactuca sativa, 'Little Gem') cultivated under different white light-emitting diodes (LED) lighting to Se content in hydroponic solution.

Materials and methods. Experiments were performed in closed controlled environment walk-in growth chambers (length 4 m × 6 m) in the phytotron complex at the Institute of Horticulture (IH), Research Centre for Agriculture and Forestry, Lithuania. Lettuces (*Lactuca sativa*, 'Little Gem') (CN Seeds Ltd, Pymoor, Ely, Cambridgeshire, UK) grown as baby leaves were used in the experiments. One lettuce seed was sown in rockwool cubes (2 × 2 × 3.5 cm) soaked with deionized water. Seeds were germinated and seedlings were grown under high-pressure sodium lamps (HPS–SonT Agro 400 w, Philips, Eindhoven, Netherlands) in an 18-hour photoperiod with day/night temperatures (±SD) of 21/17 ± 2 °C and a relative air humidity of 60 ± 5%. The nutrient solution was added at the cotyledon stage. Similar-sized lettuce seedlings were transplanted into 9-L hydroponic containers on the 11th day after sowing (DAS). The experiments were repeated twice. Modified Hoagland nutrient solution with the average concentration of nutrients of [mg L^{-1}] N, 120; P, 20; K, 128; Ca, 88; Mg, 40; S, 53; Fe, 1.6; Mn, 0.08; Cu, 0.08; B, 0.16; Zn, 0.8; Mo, 0.2 were used from seedling stage until the end of experiments. The pH was 5.5–6.5, and the electrical conductivity (EC) was 1.3–1.7 mS cm^{-1} (GroLine HI9814, Hanna Instruments, Woonsocket, RI, USA). Se (1 ppm) experiment was performed using sodium selenate (Na_2SeO_4). Transplanted lettuces were cultivated under different white 3000K, 3500K, and 4000K light-emitting diodes (LED) lighting. All lighting treatments delivered the same total photon flux density (TPFD) of 220 µmol m^{-2} s^{-1}. The photon distributions of all lighting treatments were measured using a portable photometer-radiometer at the tray surface level (RF-100, Sonopan, Poland). There were determined content of mineral elements (Se – selenium, P-phosphorus, K - potassium, Ca – calcium, S – sulphur, Mg – magnesium, Fe – iron, Zn – zinc, DPPH - 2-diphenyl-1-picrylhydrazyl free radical scavenging activity, ABTS - 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic) acid free scavenging activity and FRAP - ferric reducing antioxidant power. Statistical analysis was performed using Microsoft Excel 2016 and Addinsoft XLSTAT 2019.1 XLSTAT statistical and data analysis solution (Long Island, NY, USA). Means with different letters within each column are significantly different at the $P < 0.05$ level according to Tukey's honestly significant difference test.

Results



Conclusions. The significantly higher Se content and translocation factor were determined under 3500K LEDs. Meanwhile, the bioconcentration factor was lower under this lighting. Se negatively affected S content under whole white LED lighting but had no significant impact on P, K, Ca and Mg content. However, Se resulted in decrease Fe and Zn under 3000K LED lighting. Lettuce growth was more dependent on light but not Se content in the hydroponic solution. The most positive effect on their growth was determined under 3000K LEDs. The highest content of fructose and glucose was under 3500 LEDs. Se exposure increased saccharose under 3500K, DPPH under 4000K LEDs but did not affect FRAP and ABTS under whole white LED lighting. These results suggest that Se and 3500K LEDs lighting interaction is most suitable for cultivating selenium-biofortified lettuce.

Acknowledgement. This project has received funding from the Research Council of Lithuania (LMTLT), agreement No. S-MIP-19-2.

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