New lighting strategy for indoor leafy greens by segmenting the photoperiod and replacing the dark period by their light compensation point


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Material and methods

Three lighting treatments were compared for 4 leafy greens (arugula, erucic sativa Mill., lettuce, Lactuca sativa L. cvs Salanova Green and Red Butter, and Bergam’s Green) grown in growth chambers under LED having a Blue: Red ratio of 0.13. Exposing lettuce to three light treatments (three LCP) under the 6L/6LCP treatment, showing a low light adaptation compared with 5L/1N treated plants. For all species or cultivars, PImax/Fv/Fm ratio, performance index of PSII, rate of leaf dark respiration (Rd), light compensation point (LCP) and light saturation point (LSP) of four leafy greens (BG: Bergam’s Green; A: arugula; SG: lettuce cv Salanova Green; RB: lettuce cv Salanova Red) exposed to three light treatments (n=2 to 15).

Results and discussion

For arugula, the use of SL/1LCP reduced the SPAD value by 18% and a slight increase was observed for Fv/Fm (+2.5%) compared with the other light treatments (Table 1). For all studied species, the Fv/Fm ratio was within the 0.80-0.84 values generally considered for 3 plants, showing the absence of stress under short night (IN) or continuous lighting (LCP). The apparent quantum yield (Φ) of arugula increased by 41% under SL/6LCP compared with SL/1N and SL/1LCP. For all species or cultivars, PI was higher under SL/6LCP and the light saturation point (LSP) was lower (<260) under the 6L/6LCP treatment, showing a low light adaptation compared with SL/1N and SL/1LCP. SR showed a lower shoot fresh weight (SWF) under 6L/6LCP (-37%) compared with SL/1LCP. For arugula, SL/1LCP decreased the shoot dry biomass of BG (-28%) compared with SL/1N and 6L/6LCP, while its leaf area increased (+43%). The leaf area of SL/1LCP also increased (+54%) under SL/1LCP compared with 6L/6LCP, without any effect on the plant biomass. For arugula, SL/1LCP reduced by 29% the shoot dry biomass compared with SL/6LCP. Based on fresh biomass, the photon yield of SR exposed to 6L/6LCP was 44% lower compared with the two other treatments. However, on a dry weight basis, 6L/6LCP increased the photon yield of BG by 29% compared with SL/1LCP, while SL/1LCP decreased the photon yield of arugula compared with SL/1N.

Conclusions

A higher DLI, for A, SG and SR, with relatively low PPFD and long photoperiod (SL/1LCP) may increase fresh shoot biomass more than a higher PPFD and shorter photoperiod (6L/6LCP). SL/1LCP may reduce the lettuce SWL, while a positive effect may be observed for arugula. SL/1LCP reduced the shoot dry weight of arugula and BG compared with SL/1N, although no effect was observed for SG and SR. For arugula, SL/1N increased the leaf fresh weight (FW) by 31%, while leafy greens exposed alternatively to a short photoperiod having high PPFD followed by an equivalent (6L/6LCP) or shorter photoperiod of low PPFD (SL/1LCP), corresponding to their LCP, did not have a better light use efficiency and productivity than plants grown under moderate PPFD with a short dark period (SL/1N).

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